TECHNICAL MANUAL

MAINTENANCE

OF

RAILWAY CAR

H E A D Q U A R T E R S , D E P A R T M E N T O F T H E A R M Y

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MAINTENANCE OF RAILWAY CARS

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PART ONE
GENERAL
CHAPTER 1
INTRODUCTION

1-1. Purpose and Scope

a. This manual provides information and guidance to personnel concerned with the operation, inspection, and maintenance of Department of the Army-owned continental United States railway intraplant freight equipment, and interchange freight and passenger equipment. It describes the principal parts of freight cars and passenger cars and gives detailed instructions for their inspection and maintenance. It includes basic details of car construction and describes types of light and heavy repairs. Necessary equipment for maintenance and repair is described, and pertinent forms are illustrated and explained. Instructions are given for standard painting, lettering, and numbering of freight cars and passenger cars.

b. The material presented herein is applicable without modification to both nuclear and nonnuclear warfare.

1-2. Modifications

Users of this publication are encouraged to submit recommended changes and comments to improve the publication Comments should be keyed to the specific page, paragraph, and line of the text in which the change is recommended. Reasons will be provided for each comment to insure understanding and complete evaluation. Comments should be prepared using DA Form 2028 (Recommended Changes to Publications) and forwarded direct to the Commandant, US Army Transportation School, ATTN: Director of Doctrine Development, Literature and Plans, Fort -Eustis, Virginia 23604.

1-3. Responsibilities

a. The Military Traffic Management and Terminal Service (MTMTS) is responsible for the control, distribution, utilization, and maintenance of, and the accountability for railway freight and tank cars that are owned or leased by or loaned to MTMTS and assigned to the Defense Freight Railway Interchange Fleet (DFRIF).

b. The US Army Mobility Equipment Command (MECOM) is responsible for the maintenance of utility rail equipment used by the Army and other Department of Defense (DOD) agencies having InterservIce Support Agreements with MECOM, and for the operation of the Mobile Rail Repair Shops (MRRS) to provide direct and general support maintenance to such equipment, as provided by AR 700-53.

CHAPTER 2

TYPES OF ARMY-OWNED CARS

2-1. General

Railway cars are generally identified by type as house cars, open-top cars, flatcars, tank cars, passenger cars, and special-purpose cars. Each car unit within these categories actually is an, assembly of various components, and each component has a definite function and place. These components are discussed in succeeding chapters. Within the types, there are many kinds of cars. The most common house cars are boxcars and refrigerator cars. Passenger cars include coaches, sleepers, diner or kitchen cars, guard cars, etc. any type that transports personnel. Army-owned rolling stock, worldwide, includes cars of all the types discussed herein.

2-2. Cars for Conus Service

In the continental United States (CONUS), Department of Defense (DOD)-owned freight and passenger cars, including Army Medical Department ambulance cars, troop kitchen cars, and guard cars, are constructed in conformance with Association of American Railroads (AAR) and Department of Transportation (DOT) specifications so as to be readily movable in interchange service. The major portion of DOD-owned cars in CONUS consists of heavy duty flatcars and the tank car fleet Use and movement of these cars are controlled by the Military Traffic Management and Terminal Service (MTMTS).

2-3. Cars for Oversea Service

a. Freight Cars. In foreign countries, low capacity cars (15 to 20 tons, 4-wheel, 2-axle) are standard. During World War II, a shortage of available shipping and the necessity for saving shipping space brought about the hurried design of knocked-down cars patterned after European cars. These and a few 40-ton flatcars, boxcars, gondolas, and tank cars of modified American 8wheeled type made up the standard gage (5,6 1/ 2-in-ch) cars produced and sent to Europe for use by the Transportation Railway Service (TRS) during World War II. For use in theaters of operations where narrow-gage tracks (39 3/8-inch and 42-inch) predominated, 8-wheel, 4-axle boxcars, flatcars, gondolas, and tank cars of 30-ton capacity were designed After World War II, action. was initiated by the Chief of Transportation to develop railway equipment to fit railway operating conditions in world areas considered strategically important. During 1951-53, to meet urgent military railway service requirements, a large number of US type standard-gage freight cars, including refrigerator cars, were constructed and sent to Korea. From 1966 to 1968, metergage gondolas, flatcars, and refrigerator cars (fig. 2-1 and 2-2) were built and sent to Vietnam. Limiting factors such as track gage and allowable axle-load, restricted by track and bridge load limits and clearance dimensions, have affected oversea fleet car dimensions and design capacity. This problem was solved by the development of the multigage truck and axle whereby the wheels may be pressed in or out, to fit the various track gages. This led to the development of the knockdown fleet-standard-gage cars (56 1/2 inches) to broad gage (60, 63, and 66 inches) with a capacity of 40 tons, and narrow-gage cars (36, 39 3/8, and 42 inches) with 30-ton capacity. Both fleets, the 30and 40-ton, include flatcars, boxcars, gondolas, and tank cars. Field and depot maintenance repair parts lists, special tool lists and assembly instructions for this type of railway rolling stock are contained in technical manuals of the TM 55-2220-series.

b. Passenger-Type Cars. During World War II, one oversea train of 10 ambulance cars was shipped to Europe. These were not passenger type cars. They were an experimental freight-car type which proved inadequate Thereafter, throughout the war, all ambulance service was accomplished with converted indigenous passenger-type equipment Development of ambulance train cars for oversea service since has resulted in the construction of pilot models of one ambulance car, one personnel car, and one kitchen dining-storage car.

Figure 2-1. Railway car (ice), Refrigerator, 56 ½-inch gage, 50-ton, 8-wheel, foreign service.

2-4. House Cars

a. General. A house car is a car with an enclosed superstructure which has sides, ends, and a roof, and which is provided with doors, vents, ladders, and running boards. A house car is built on a conventional underframe and has conventional running gear. Figures 2-1 and 2-2 illustrate the exterior of foreign service refrigerator cars. An interior view is shown in figure 2-3.

b. Usage. In oversea service, only three types of house cars will be used: boxcars, refrigerator cars, and caboose or guard cars. The major characteristics of these types will be discussed, and only limited coverage will be given to miscellaneous types.

2-5. Open-Top Cars

a. General. Open-top cars include gondola, hopper, and ballast cars, but not flatcars. For the purpose of this manual, gondola and hopper cars, which constitute more than 90 percent of open-top types, will be considered exclusively. All-steel gondola and hopper cars are of diverse types. Some consist of fixed sides, ends and bottoms. A 40-ton, high-side gondola is illustrated in figure 2-4. Other types have drop sides and/ or drop bottoms or, in the case of the hoppers, drop doors. The design of side and end framing has given the gondola and hopper car high load capacities, safety, and durability. The components of these cars, except for superstructure and an underframe designed for heavy loads, are almost identical with those of other cars of equivalent load limits. Drawings showing the gondola underframe design load capacity are available from the US Army Mobility Equipment Command, St. Louis, Missouri 63120.

b. Usage. Drop ends are an asset when it is necessary to load long material or when the car is used to transport machinery that extends beyond the end limits of the car. In gondola cars with drop ends, the entire end swings inward and

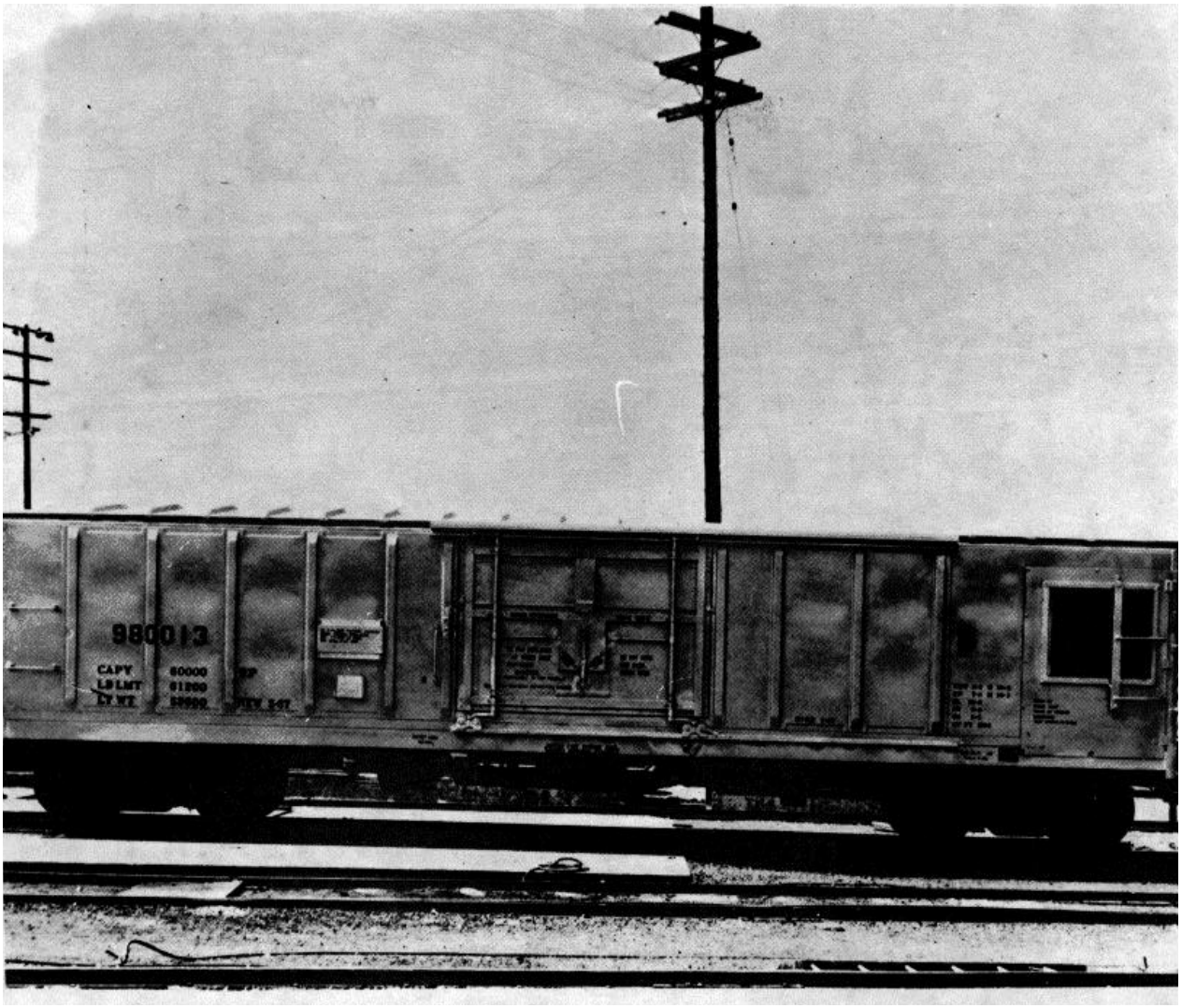


Figure 2-2. Railway car (mechanical), refrigerator, 39 3/8-inch gage, 40-ton 8-wheel, foreign service.

lies flat on the deck of the car. Locking devices connect the ends to the fixed sides of the car and are designed with interlocking features to prevent the spreading of car sides at corners. Drop door hoppers facilitate the unloading of such commodities as coal and sand.

2-6. Flatcars

a. General. A flatcar is a freight car with a wooden or steel floor built over the underframe sills, but without a superstructure With load capacities ranging from 40 to 250 tons, flatcars are considered the workhorses of the railway service. Trucks, draft gear, couplers, safety appliances, and brake gear are identical with those of other types of freight-car equipment With the exception of the US Army 100-ton capacity, heavy-duty flatcars (shown in fig. 2-5(1)), no flatcars have been built for passenger-train service. These flatcars have steam, air signal, and airbrake trainlines and special trucks, brake gear, couplers, and draft gear to permit service in passenger trains.

b. Usage. Modern flatcars decks (or flooring) usually are laid with heavy wood timbers to facilitate blocking and bracing of various loads. Flatcars are particularly suitable for outsize items, long objects such as poles, steel beams, etc., which may extend over two or more cars. There are several types of special-purpose cars built from basic flatcar design The two most commonly used in CONUS, but not presently in the military fleet, are the double-deck and triple deck cars designed specifically for the transport of vehicles and the flatcars with built-up end walls used primarily for movement of logs and lumber

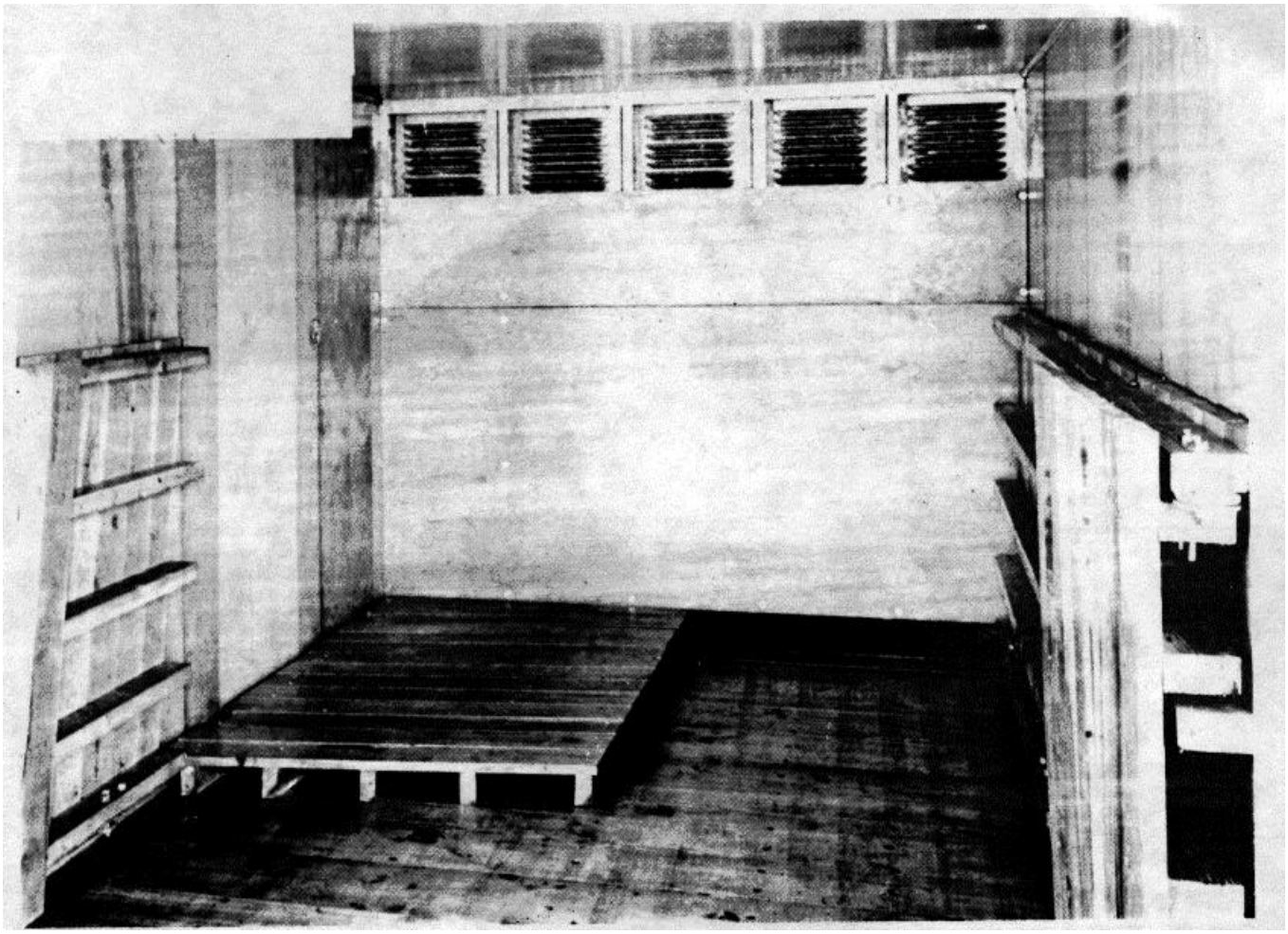


Figure 2-3. Interior view of railway car (ice), refrigerator, 56 ½-inch gage, 50-ton, 8-wheel, foreign service.

products. Other types include the depressed-center cars shown in figure 2-5(2), used for moving tall objects where maximum clearances are required.

2-7. Tank Cars

a. General. Except for their superstructure (tank) and a modified underframe, tank car components are similar to those of other types of cars. Tank car underframes are designed and built without load-bearing side sills between bolsters. The weight of the tank superstructure with lading is 'borne by the center sills, with the main anchorage and bearing at the bolsters. A conventional tank car (fig 2-6) consists of a tank, usually steel, mounted on a special underframe. Draft 'gear, couplers, brake gear, and trucks are similar to those of other cars of the same load design. The ordinary tank car has a single-compartment tank equipped with dome safety valves and bottom outlets Other tank cars of the conventional type may be equipped with tank baffles or even with multiple compartment tanks.

b. Usage. Approximately 300 different liquid or semiliquid commodities are transported in tank cars. These products include crude oil; fuel oil; lubricating oils; gasoline; kerosene; alcohols; acids; alkalis; coal-tar products; chlorine; bleaches; insecticides; fungicides; animal, vegetable, and fish oils; fruit juices; milk; paint; varnishes; lacquers; and compressed gases. In addition to the conventional tank cars, there are special ones such as those with removable tank units and those with wooden tanks. These types require anchorage features different from cars of the conventional single-tank pattern. As special purpose tank cars have little or no military application, only conventional tank cars will be discussed in this manual. The Department of Transportation (DOT) issues regulations and specifications for tank cars, because flammable and

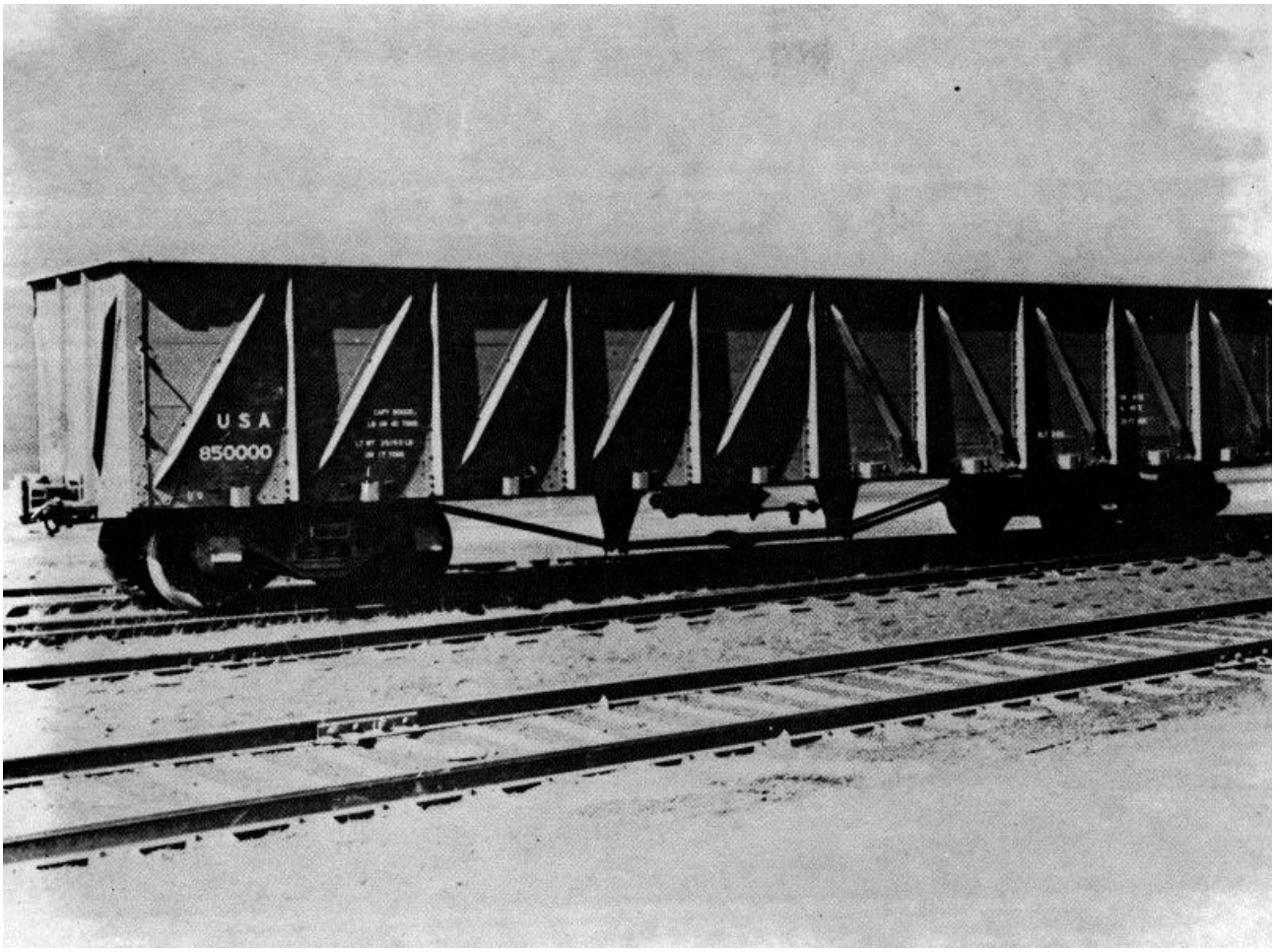


Figure 2-4. High-side, fixed-end, 40-ton gondola, domestic service.

explosive commodities are often transported in them. DOT specifications are combined with specifications of the Association of American Railroads (AAR) covering car construction into one set of specifications, which is published by the DOT.

2-8. Passenger Cars

a. General. The underframe and superstructure of passenger-type cars . are all steel or some other metal of equivalent strength. Passenger train-type cars owned by the Department of Defense have UC, D-22, or AB brake equipment modified for passenger-train operations.

b. Usage. DOD-owned passenger-type equipment consists largely of ambulance (hospital) cars, troop kitchen, and guard cars. Ambulance cars are strategically located to be used by the Surgeon General, US Army as required in the movement of sick and wounded personnel. Guard cars transport Army security personnel when accompanying classified shipments over CONUS commercial railroads. Examples of these passenger-type cars are shown in figures 2-7 and 2-8.

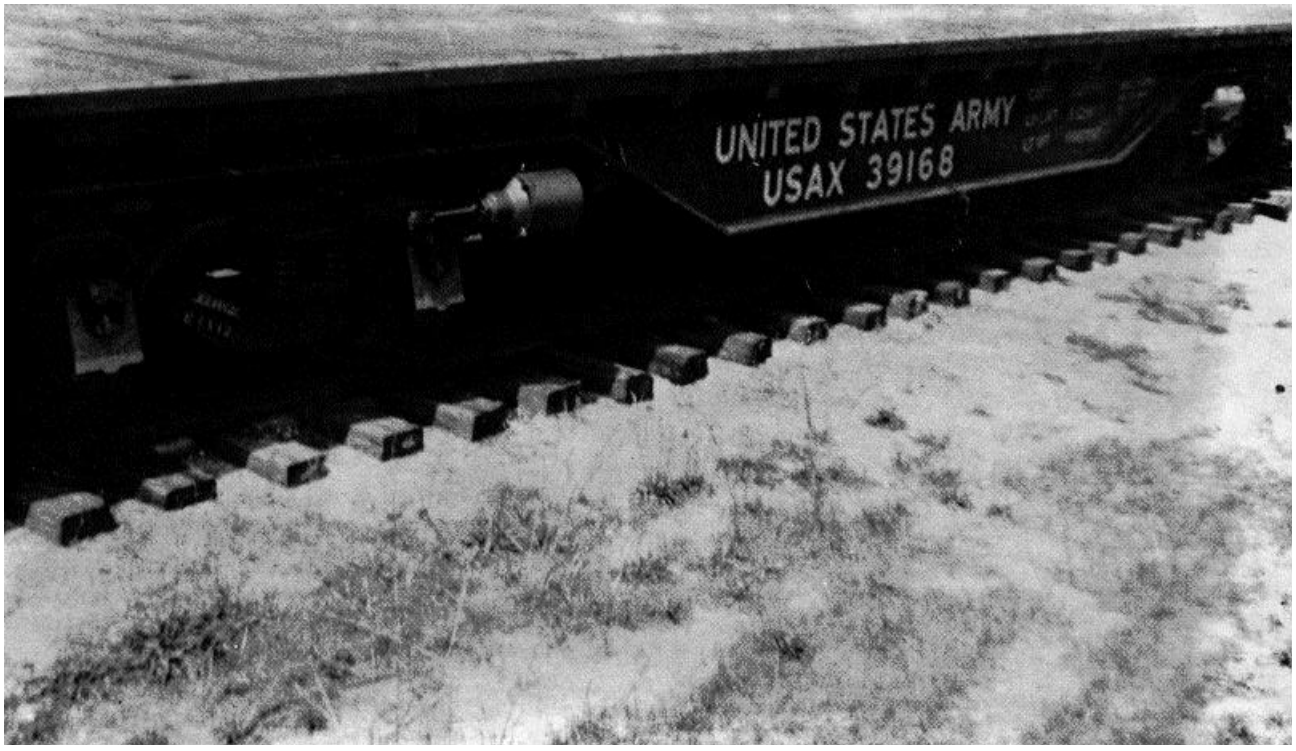


Figure 2-5(1). A 100-ton heavy-duty flatcar.

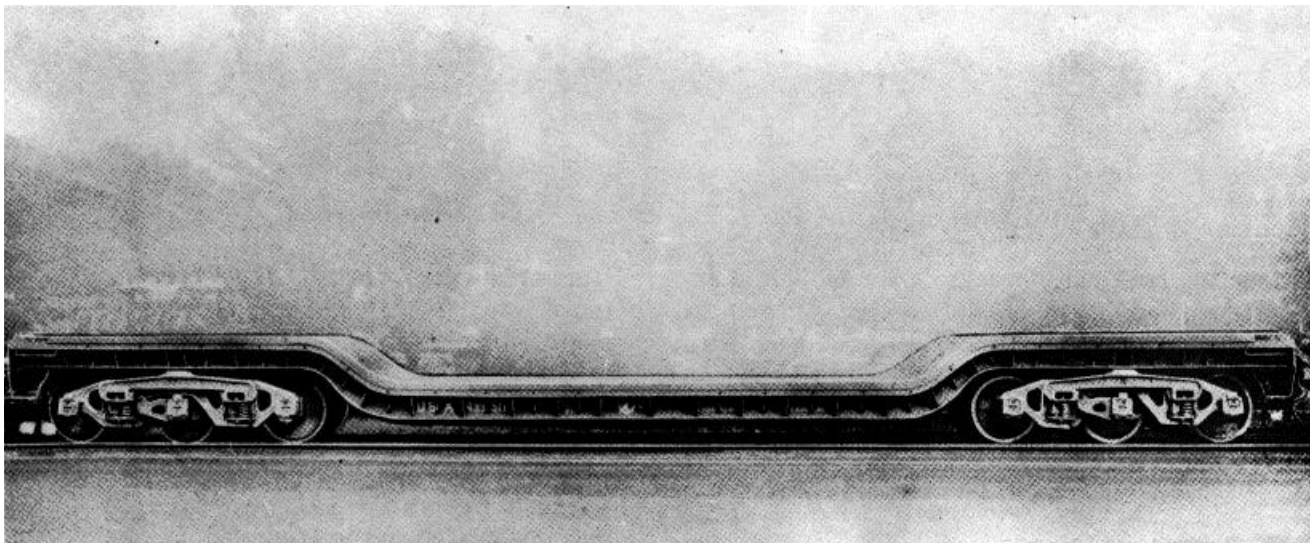


Figure 2-5(2). A depressed-center flatcar.

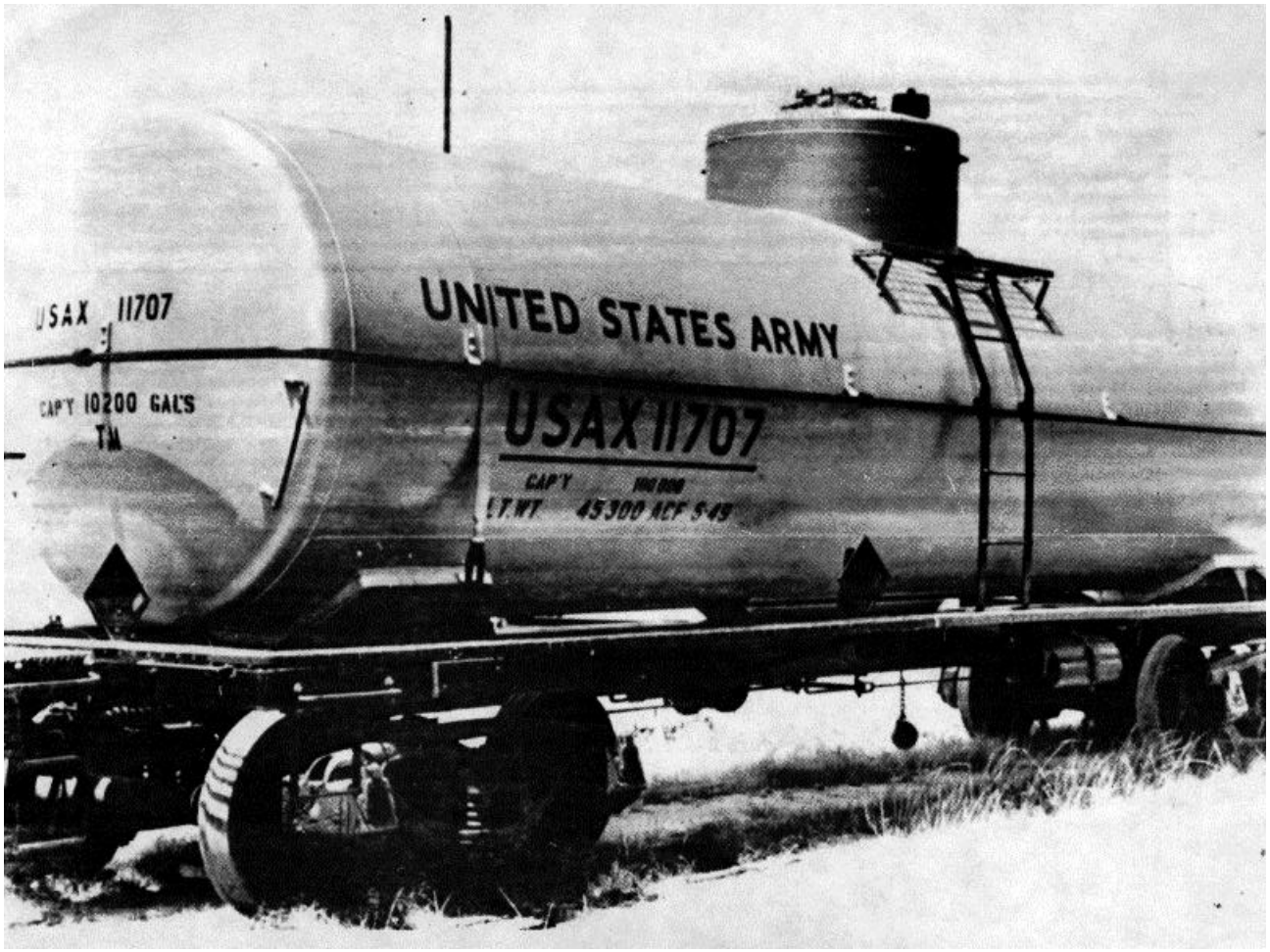


Figure 2-6. Railway tank car, petroleum, 56 ½-inch gage, 10,000-gallon 8-wheel, domestic service.

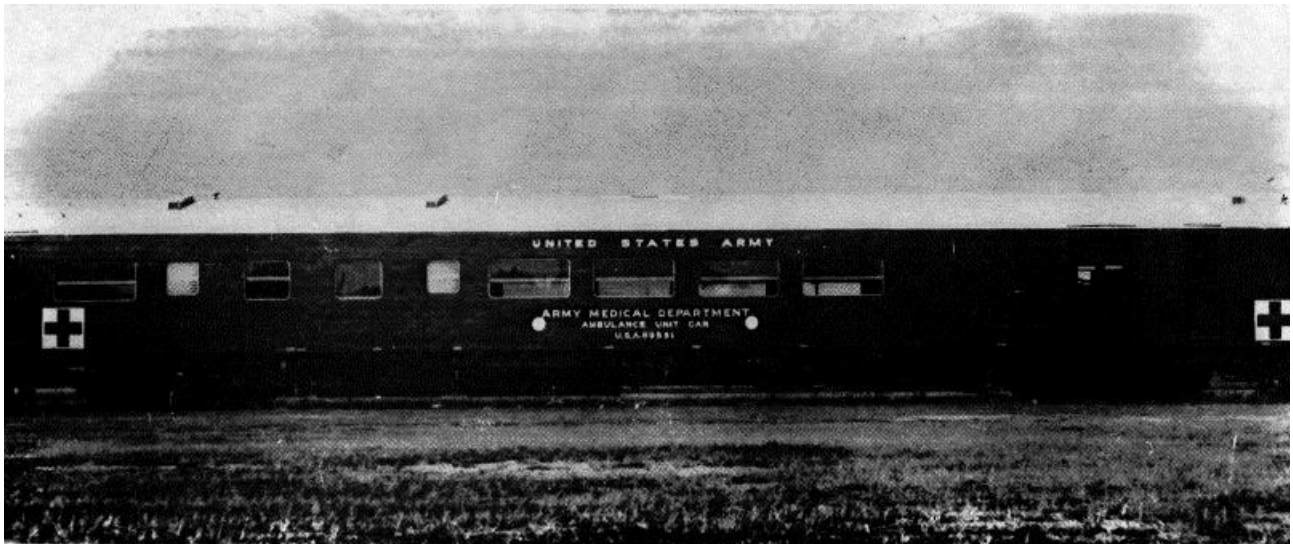


Figure 2-7. Army Medical Department ambulance unit car, domestic service.

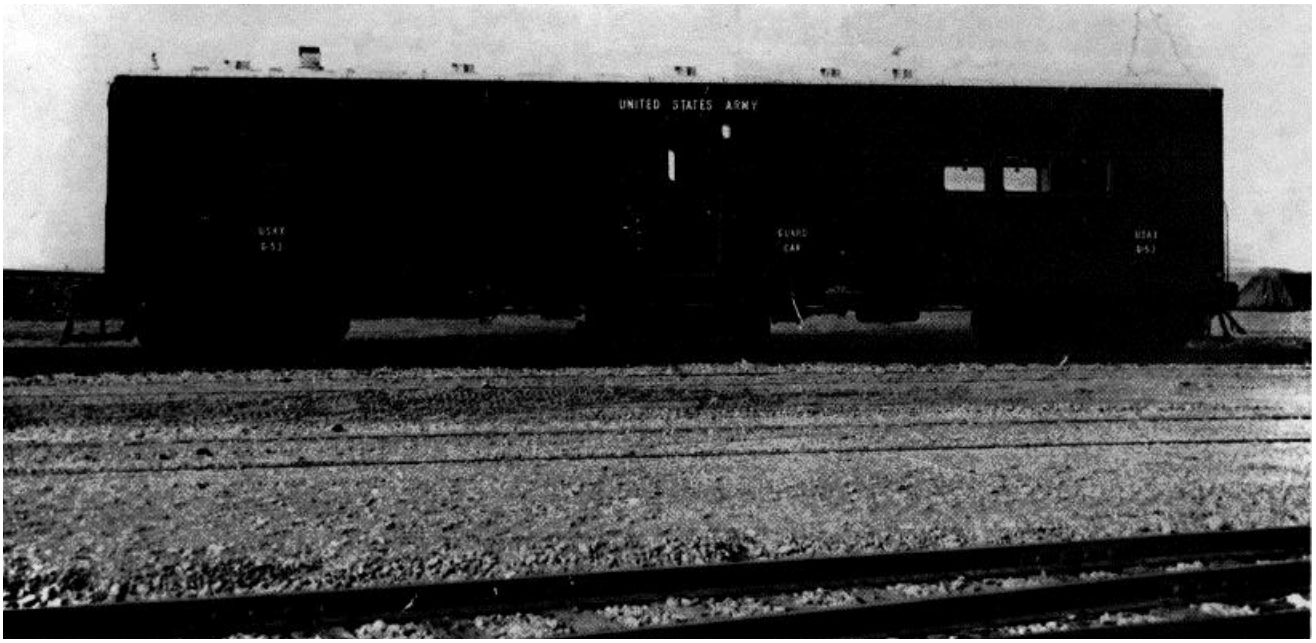


Figure 2-8. US Army guard car.

PART TWO

RAILWAY ROLLING STOCK

CHAPTER 3

BASIC COMPONENTS

3-1. General

All railway rolling stock, of whatever type, generally will include six basic components, i.e., the trucks (wheels), underframe, draft gear, brake gear, couplers, and superstructure (body). There are exceptions. Flatcars generally have no superstructure, and many cars in oversea areas are equipped only with handbrakes; some foreign cars, in fact, have no brakes at all. Other cars on foreign railroads have hook-and-link couplings with a buffer arrangement in lieu of an automatic coupler with a draft gear. The various car components are discussed separately with general and detailed inspection and maintenance procedures indicated as applicable.

3-2. Trucks

Truck is the term used to designate the wheeled assembly which, at each end of the car, supports the underframe or underframe and superstructure of a freight or passenger car. It may consist -of one, two, or more pairs of wheels. Many European-type freight cars have only two pairs of wheels (or bogies), one at each end. On most CONUS freight equipment, 4-wheel trucks (fig 3-1) are standard. Heavy-duty flatcars and passenger cars are usually equipped with 6-wheel trucks. A truck acceptable for service is flexible enough so that it rides without interfering with other parts of the car, and its wheels follow curves in the track without climbing the rails to cause possible derailment. Essential parts most likely to require repairs or replacement are readily accessible, and all truck parts meet prescribed standards. Pedestal-type trucks and parts are today unusual in general-service freight equipment, except on trucks with roller bearings. A passenger car truck assembly is designed to meet all interlocking and structural requirements, provide proper flexibility to insure free riding, and have good wheel-used under passenger cars.

tracking performance in service. The resemblance of passenger-car trucks to those of freight cars is limited to similarity in function. High-speed operations necessitate a type of truck for passenger cars which includes features for the ,safety of :passengers in the event of abnormal accidental impact, swing suspensions with vertical and lateral snubbing devices, and truck mounted brake cylinders and brake gear. Car trucks are discussed in detail in chapter 4.

3-3. Oversea Fleet Truck Parts

The truck parts of the Department of the Army (DA) 40-ton fleet differ in size from those of the 30-ton fleet. However, truck parts within each fleet are identical and interchangeable. For example, depot stocks of oversea truck side frames, bolsters, bolster springs, dust guards, journal bearings, wedges, etc., as well as wheels and axles, are identical -and interchangeable with the parts of all trucks or cars of equal capacities. The truck frame for the 40-ton fleet, except for the lightweight side frame and the chilled cast-iron wheels, which have been modified to meet operating conditions overseas, is similar to or is a modification of truck components used on continental United States (CONUS) railways, and the wear limits and maintenance practices of CONUS railways are applicable.

3-4. Wheels and Axles

a. Wheels. Car wheels are of three general types: cast iron, cast steel, and wrought steel. Cast-iron wheels are no longer used by commercial railroads in CONUS, but are discussed herein because they are component parts of the 30-ton and 40-ton oversea military car fleet and are in service under Army-owned freight cars in oversea areas. Wrought steel wheels are generally

Figure 3-1. AAR standard 4-wheel, coil spring, cast bolster car truck.

b. Axles. A car axle is a solid axle with either solid (friction) bearings or roller bearings. The axle not only holds the wheels to gage, it also transmits the load from the Journal bearing to the wheels. The extreme ends of the axle are known as journals; these are turned to size and then burnished to a polish. That portion between the wheel seat and the back journal fillet seats the dust guard and is therefore known as the dustguard collar. The wheel seat follows the dustguard collar. The axle diameter at this point is fixed by regulations covering standard axle dimensions and condemning limits (minimum diameters and maximum lengths for which an axle will be continued in. service). Wheels and axles are fully discussed in paragraph 4-3 through 4-11.

3-5. Underframe

The underframe is the framework which receives the buffing and pulling stresses and carries the combined weight of the car and lading. The underframe consists of all the framing below the floor, including the sills (center and side), platforms, bolsters, crossbearers, crossties, end sills, striking plates, and required safety attachments. (See chapter 5 for discussion of underframe assemblies, etc.)

3-6. Draft Gear

The draft gears located at each end of the car connect the coupler to the underframe. The ends of the draft gear bear against the shoulders of the draft casting or lugs, which are riveted or

welded to the center sills. These castings or lugs transmit to the sills and the remainder of the car the stresses received from the draft gear. Draft gears cushion the shocks between cars when they are being coupled or when speed is suddenly changed. Instead of a shock, there is a gradually increasing push or pull against the car structure. These shocks are a result of the so-called run-in or run-out of slack purposely left in the couplers to permit a train to be started one car at a time. Original draft gears were of the spring type. Modern cars, however, have either the spring type coupled with friction devices to dampen the recoil that ordinarily accompanies the release of a compressed spring or the recently developed rubber-cushion type. (See chapter 6 for more detailed discussion of draft gears.)

3-7. Couplers, CONUS Cars

The coupler is the device which connects one car to another, maintains the connection, and disconnects the cars. The AAR type E coupler is standard on the railroads of the United States for freight service Although some cars built before 1933 are still equipped with type D couplers, the type E coupler has been required on all cars built since 1933. Two types of coupler shanks are available, known respectively as the rigid shank and the swivel-butt shank. The swivel-butt shank permits horizontal radial action by the coupler with respect to the longitudinal centerline of the car. This arrangement is an advantage when coupling on curved track. These couplers are discussed and illustrated in chapter 7.

3-8. Couplers, Oversea Railway Equipment

With few exceptions, hook-and-link and Willison couplers set at 41 inches coupler height predominate in oversea areas. The exceptions are those areas such as Korea, Japan, and China where AAR-type automatic couplers are used Neither hook-and-link nor Willison couplers transmit buff directly to the center sill through draft gears. Buff loads are taken up by two side buffers at coupler height above the top of the rail. Each buffer is set approximately 35 inches off the longitudinal centerline of the car. Design loads are fixed for both buffers and the hook and links of the coupler. This design establishes the maximum drawbar pull allowed when fixing train tonnages, and the useful life of the coupler is directly related to the amount of misuse brought about by overloading. One of the outstanding characteristics of the hook-and-link coupler is that the design provides for no built-in slack between cars. Links are turned tight by turnbuckles, thus losing all slack. These two coupling devices are discussed and illustrated in chapter 7 One illustration, figure 7-6, depicts the side buffer arrangement.

3-9. Superstructure

Railway rolling stock superstructures include everything installed above the floor. As previously noted, flatcars generally have no superstructures. Certain flatcars used exclusively for moving logs in commercial service may have end boards to keep the logs in place The superstructure, or car body, is built upon the car underframe. It is designed to fit a particular type of car and purpose. Typical examples in common use include box, refrigerator, and tank cars, gondolas and hoppers, coaches, kitchen and dining cars, ambulance, guard, and sleeping cars. Superstructures include sides, ends, tops, roofs, seats, berths, tanks, etc., as applicable to the purpose of a particular type of car.

CHAPTER 4

CAR TRUCK MAINTENANCE

Section I. GENERAL

4-1. Types of Trucks

a. General. Car trucks have been generally described in paragraph 3-2. There are many different types, but the same general characteristics are applicable to all This text is largely limited to the conventional, 4-wheel, cast bolster, coil spring, side frame freight car truck (fig 3-1), discussed in paragraphs 4-19 through 4-21.

b. Inspection. The inspection, repair, and maintenance of car trucks is an essential part of railway operations, as the wheels must roll to move personnel, equipment, and supplies by rail. Wheel flanges wear sharp, treads wear thin, and brakeshoes wear out. The diameter of car wheel journals decreases and the length increases with service. Car journals wear down until they are uneven or the journal finish reaches the danger point. When this occurs, the defective surface must be smoothed and polished to create a new wearing surface. This wear and reconditioning eventually will reduce the journal to an unsafe diameter and length. The length may also become so great as to make lateral movement of the bearing and journal excessive for safe operation.

4-2. Maintenance of Truck as a Unit

The body of a car may settle because of the wear of wheel treads, journals, bearings, and the possible shortening of the springs resulting from set. This settling may be of vital importance since the relative height of the settled car to other coupled cars is disturbed. However, a car can be brought up to proper level by placing shims or liners of the required thickness under the truck springs or by replacing the affected, weak springs. This will raise the truck bolster and the body of the car. Cars also can be raised by placing shims in the center plate. This requires compensating adjustment of side bearings. The proper height of a car can be established by measuring the height of the coupler from the rail level. This should not exceed 34 1/2 inches (center of coupler) on CONUS-type cars.

Section II. WHEEL AND AXLE ASSEMBLY

4-3. General

a. Wheel Wear. Friction is the main cause of wear on car wheels. This friction is developed by the contact of wheel with rail and by the contact of brakeshoes against wheel treads in braking Rail or rolling friction causes the greatest amount of wear, resulting in the development of hollow spots in the tread next to the flange. These may be caused by high speeds, heavy loads, or unevenly jointed track. As noted, the friction of the brakeshoe causes tread wear, but more important, the heat generated by brakeshoe application is gradually passed on to the flange and rim of the wheel. The tread heats rapidly when the brakes are applied; therefore, the tendency is for the tread to expand out of proportion to the rest of the wheel. Since the tread expands and the rim and flange resist expansion, cracks may develop in the plate, rim, or flange because of the stresses they bear at the time of brakeshoe application. Repeated cooling and heating of the tread develops and increases the number of cracks; frequently those cracks may result in the fracturing or breaking off of sections of the rim or flange. Wear of the flanges against the outside rail of curves results in "sharp" flanges which are inherently dangerous because such a sharp wheel may split a switch and cause a derailment.

b. Inspection. When the wheels and axles are removed from a truck for any reason, both wheels and the axle should be thoroughly examined to ascertain whether other defects are present and

if such defects are of such nature as to warrant removing the wheels from the axle for repairs or scrapping as indicated. When only one wheel is found to be defective, the wheel set (axle with pair of wheels attached) is removed. The pair of wheels containing the defective wheel can be replaced and/or sent to a wheel and axle shop for repairs. Common wheel defects are discussed and illustrated in this chapter.

4-4. Removal of Wheel and Axle Assembly

a. Method of Wheel Removal. It is not necessary to dismantle the truck completely to exchange a pair of wheels. Correct procedures are listed below.

(1) Disconnect the top brake rod from the truck live lever.

(2) Jack the car high enough to remove the truck.

(3) Place safety trestles under the car.

(4) Remove truck center pin and roll the truck out.

(5) Remove journal packing or lubricating pads, journal bearing, and wedge from wheels to be replaced.

(6) Pry side frames out far enough for the affected wheel and axle to roll clear.

(7) Lift or roll old wheels away and replace with new pair of wheels and roll into position.

(8) Replace side frame, journal bearings, wedges, and center pin.

(9) Replace truck under car.

(10) Remove trestles, lower jacks, and reconnect brake rod to live lever.

(11) Repack journal boxes with fresh packing or lubricating pads and new oil.

4-5. Wrought and Cast Steel Wheels

a. Description

(1) Wrought steel wheels and cast steel wheels are used under freight cars as well as other equipment. Both are made in a number of designs and compositions and are either heat treated or untreated. Depending upon the original rim thickness, steel wheels are classified as multiple-wear, two-wear, or one-wear wheels. Wrought steel wheels are identified by stamping on the back face of rim or -hub; cast steel wheels are identified by marking either stamped on back rim or hub face or cast on wheel plate. Multiplewear and two-wear wheels, as indicated by the name, have sufficient rim thickness to permit machining the tread and flange to new contours after the wheels have worn to thin flange, high flange, etc. One-wear wheels are intended primarily for one service period.

(2) Wrought steel wheels, untreated and heat treated are made to AAR Specifications M107. Cast steel wheels untreated and heat treated are made to AAR Specifications M-208. Both specifications cover class (U) untreated and three classes of heat treated wheels (A, B, and C, designating the carbon content of the steel). Class A indicates a relatively low carbon steel wheel; class B, an intermediate carbon steel wheel; and class C, a relatively high carbon steel wheel. Heat treatment of wrought steel wheels may be by quenching the rim only or by quenching the entire wheel; heat treatment of cast steel wheels is by quenching the rim only. The quenching is followed by tempering. Rim quenched wheels, sometimes called rim treated, are identified by stamping the letter "R" following the class letter (except that the "R" is omitted on cast steel wheels and wrought steel wheels for locomotives) and entirely quenched wheels by stamping the letter "E" following the class letter.

b. Service. The service for which the various classes of wrought steel and cast steel wheels are intended is described below:

(1) Class U-general service where untreated wheels are satisfactory.

(2) Class A-high-speed service with severe braking conditions and moderate wheel loads.

(3) Class B-high speed service with moderate braking conditions and heavier brake loads.

(4) Class C-1-service with light braking conditions and high wheel loads.

(5) Class C-2-Service with heavier braking conditions where off-tread brakes are employed.

Note. Class A wheels (lowest carbon range) are most resistant to thermal cracking. Class C wheels (highest carbon range) are most resistant to shelling conditions. The different classes of wheels should not be mixed under the same car.

c. Types

(1) One-wear wrought steel wheels are of lighter design than the multiple-wear wheels and are for use primarily under freight cars, though used to some extent under passenger train cars.

(2) Multiple-wear steel wheels are used for locomotives and passenger cars. They may also be used for freight cars. Wheels intended for use under locomotives other than steam shall have mill scale removed before application to axle.

(3) Steel tired wheels are used on steam locomotives, some electric locomotives, and to a very limited extent on diesel locomotives and passenger cars.

4-6. Wheel Defects

a. General It is not practical to elaborate on all the details of the defects that may develop In car wheels. A general description of the various defects is given below.

b. Thin Flange. The minimum flange thickness for steel wheels in service is 15/16 inch as determined by gage applied as shown in figure 4-1.

c. Vertical Flange. A wheel is condemnable for vertical flange when the gage applied as shown in figure 4-2 contacts the throat side of the flange 1 inch above the tread.

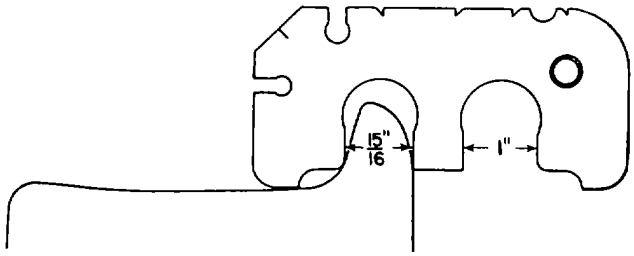


Figure 4-1. Method of gaging thin flanges, wheel condemnable.

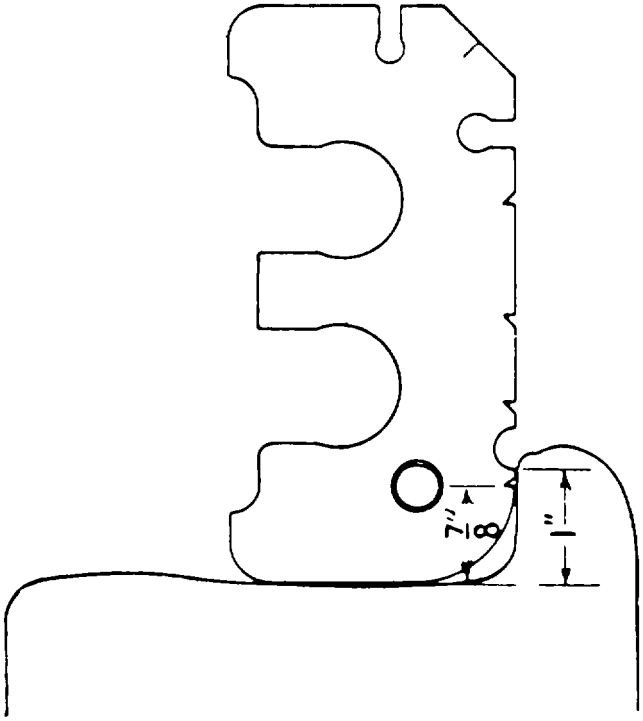


Figure 4-2. Method of gaging vertical flanges, wheel condemnable.

d. High Flange. The maximum flange height for steel wheels is 1 1/2 inches above the approximate center of tread as measured by gages as shown in figure 4-3.

e. Burnt Rim. If a portion of the flange or rim breaks off with a coarse fracture and rough granular surface (fig. 4-4), the wheel was overheated in manufacture and must be removed from service.

f. Shattered Rim. If a portion of the flange or rim parts and shows on parting a smooth surface (fig 4-5), the wheel must be removed from service.

g. Spread Rim. If the rim widens out for a short distance on the front face, an internal defect may be present, and the wheel must be withdrawn from service. This is shown in figure 4-6. Spreading of the rim is usually accompanied by a flattening of the tread, and the wheel may or may not have cracks on the tread. This condition is usually associated with a shattered rim. It is usually less than 12 inches long and should not be confused with the uniform curling over of the outer edge of the rim around the entire wheel. This latter is a common service condition and is not a defect Figure 4-7 illustrates a subsurface defect uncovered while the wheel was being turned to restore tread and flange contour. Unless these voids or flaky and/or laminated conditions can be readily turned out (within the safe wear or turning marks on the wheel), this wheel must be scrapped.

h. Shelled Tread

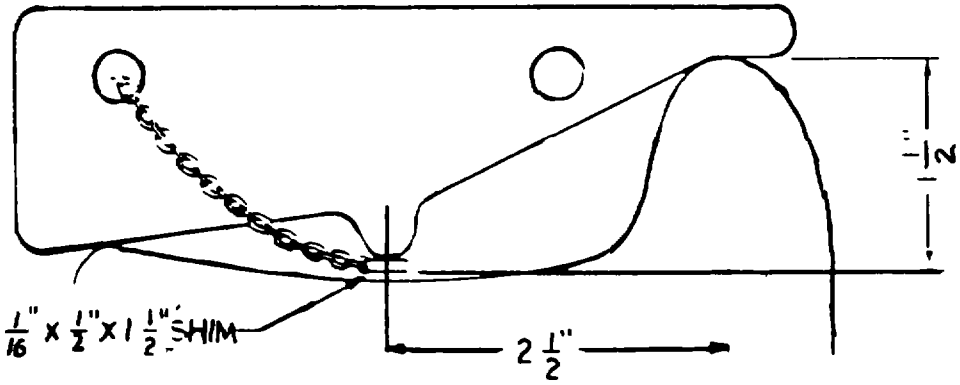
(1) When pieces of metal break out of the tread surface in several places more or less continuously around the rim, the wheel has a shelled tread and must be removed from service (fig 48).

(2) When excessive shelling occurs in service, remedial measures should be taken. Contributing factors include poor track, excessive speed, excessive load, or the use of wheels of insufficient hardness.

i. Built-Up Tread. A built-up tread is caused by metal from the tread or brakeshoe being heated to a plastic state and then dragged or built-up around the tread (fig. 4-9). Such wheels must be removed from service.

j. Grooved Tread. Wheels which have circumferential groove or grooves in the tread to a depth of 1/8 inch or more must be removed from service (fig. 4-10).

CAST STEEL WHEELS NOT HAVING FLAT BACK FACE OF RIM



ALL OTHER STEEL WHEELS

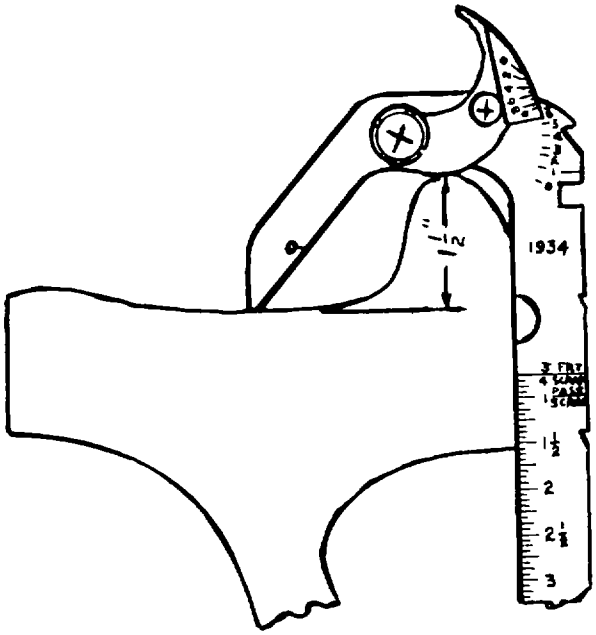


Figure 4-3. Method of measuring high flange.

k. Out of Round. Wheels which are out of round in excess of 3/64 inch within an arc of 12 inches or less with use of the gage as shown in figure 4-11 must be removed from service. This rule applies only to 33-inch wheels.

l. Cracked Hub. Hub failures take the form of radial cracks, as illustrated in figure 4-12 which shows the back hub of the wheel. They usually occur during mounting.

m. Thermal Cracks. Thermal cracks are caused by intensive brake heating. They occur crosswise on the tread as shown in figure 4-13 and may be confined to tread or flange. In extreme cases, they may go through the entire tread and into the plate. Thermal cracking is a serious defect and in any stage of development is cause for immediate removal of the wheel from service.

n. Cracked or Broken Plate. A wheel with a cracked plate is condemnable and must be removed from service. Cracks in the plate develop due to stresses from service loads and braking. Most plate cracks are progressive in nature. It is

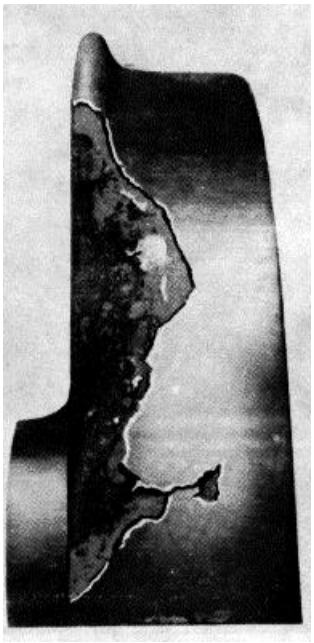


Figure 4-4. Burnt rim.

important that they be detected in their early stages. Figure 4-14(1) shows a typical plate crack that has not extended into the rim section. Figure 4-14(2) shows a crack from the plate through the rim.

o. Hole in Wheel. Wheels with holes in the plate (fig 4-15) or showing evidence of the application of a torch or electric arc are condemnable and must be withdrawn from service.

p. Wheels Loose or Out of Gage

(1) Wheels must be removed from service if they show indications of being loose on the axle. This is usually indicated by oil on the plate of the wheel, presumably having seeped through from the journal box. Loose wheels do not always have indications of oil seepage on the back plate. It is also important to watch for evidence of any wheel movement on the axle wheel seat. Oil on the back plate is sufficient reason for removing the wheels from a car even though they may not always be loose.

(2) Wheels in service which have gage measurement of less than 53 inches or more than 53 3/8 inches must be removed from service. (See figure 4-16 for method of gaging wheels.).

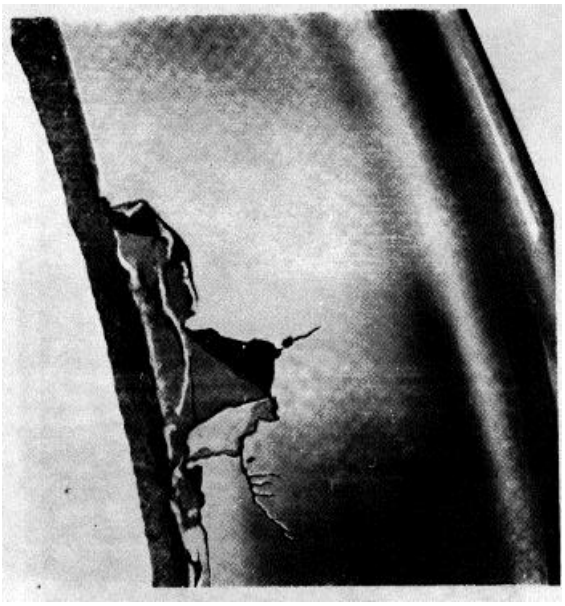


Figure 4-5. Shattered rim.

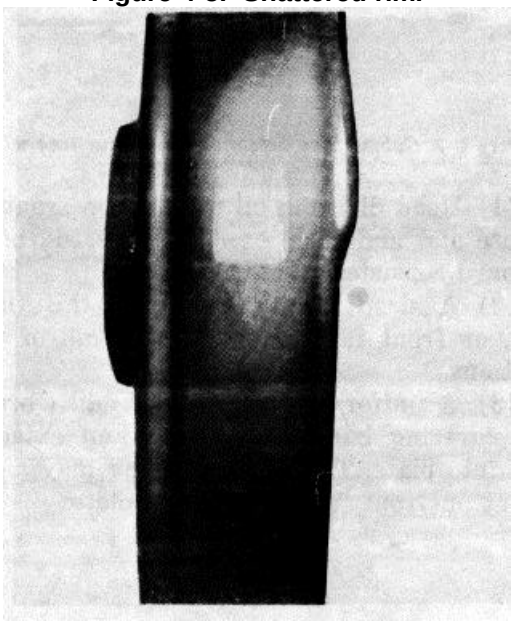


Figure 4-6. Spread rim.

q. Overheated Wheels. Wheels which become overheated due to stuck or dragging brakes and which show any one or a combination of the following evidences of severe overheating must be withdrawn from service.

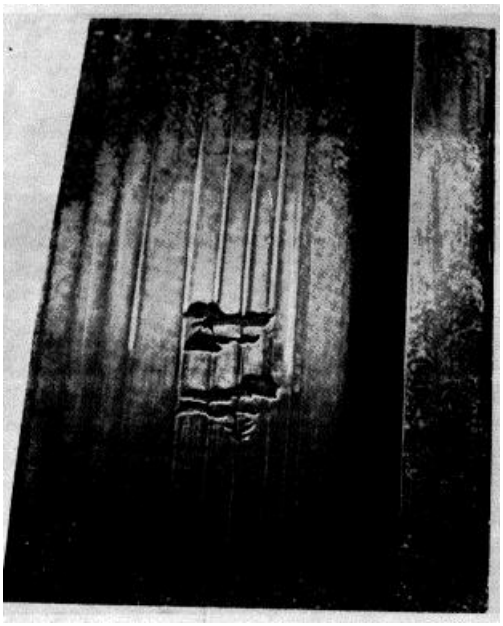


Figure 4-7. Subsurface defect found on turning wheel

(1) Road dirt and oil mixture on front face of plate and underside of rim, cindered (burnt) to a hard consistency or burnt away.

(2) A deep "blue" color on the flange, tread, or front face of rim, any or all of these conditions.

(3) A uniform pattern of "reddish brown" color covering back face of rim and extending down into plate. This same coloring may also be present on front face of rim and plate.

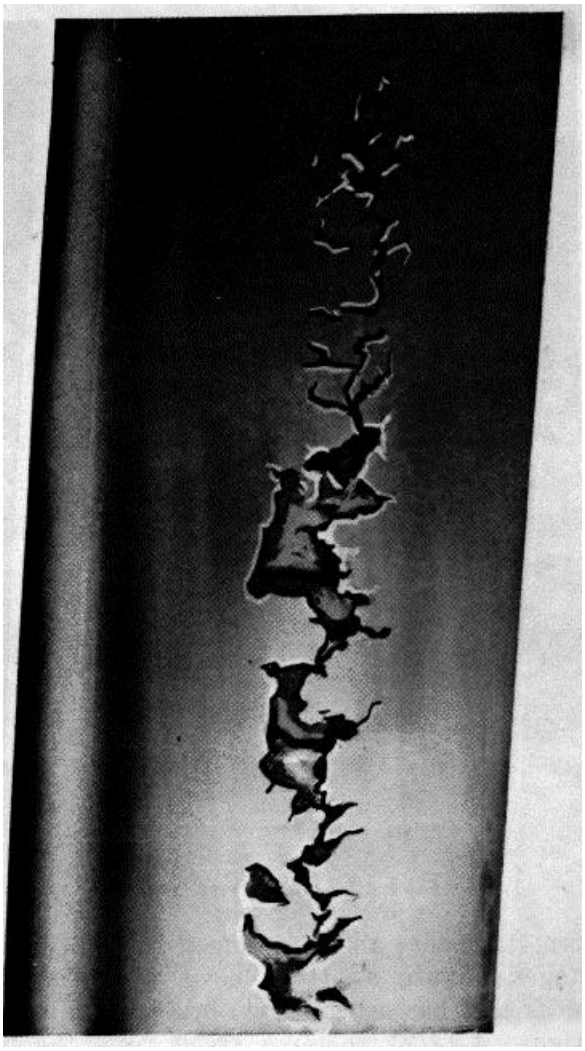


Figure 4-8. Shelled tread.

Figure 4-9. Built-up tread.

Figure 4-10. Grooved tread wheel.

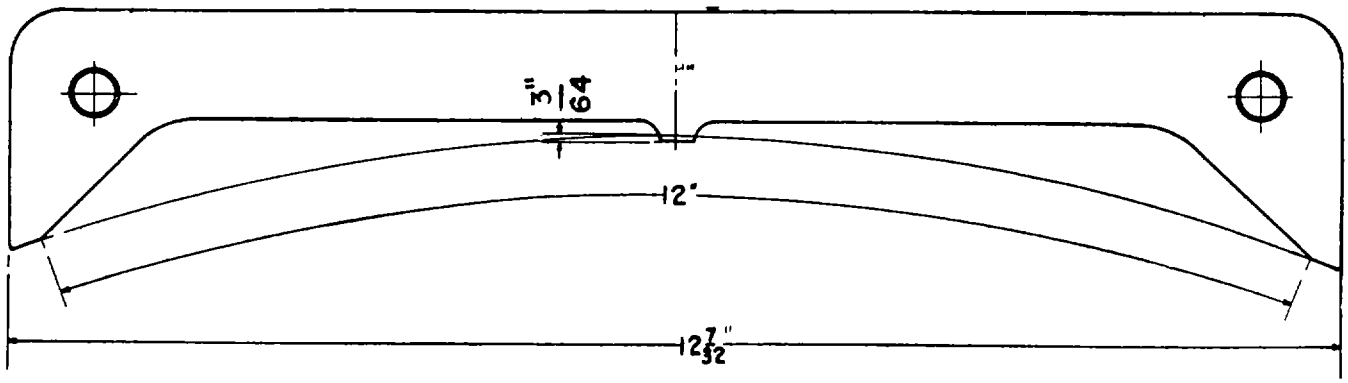


Figure 4-11. Gage for 3/64-inch worn-through spot in chill area. Out-of-round 33-inch wheel.

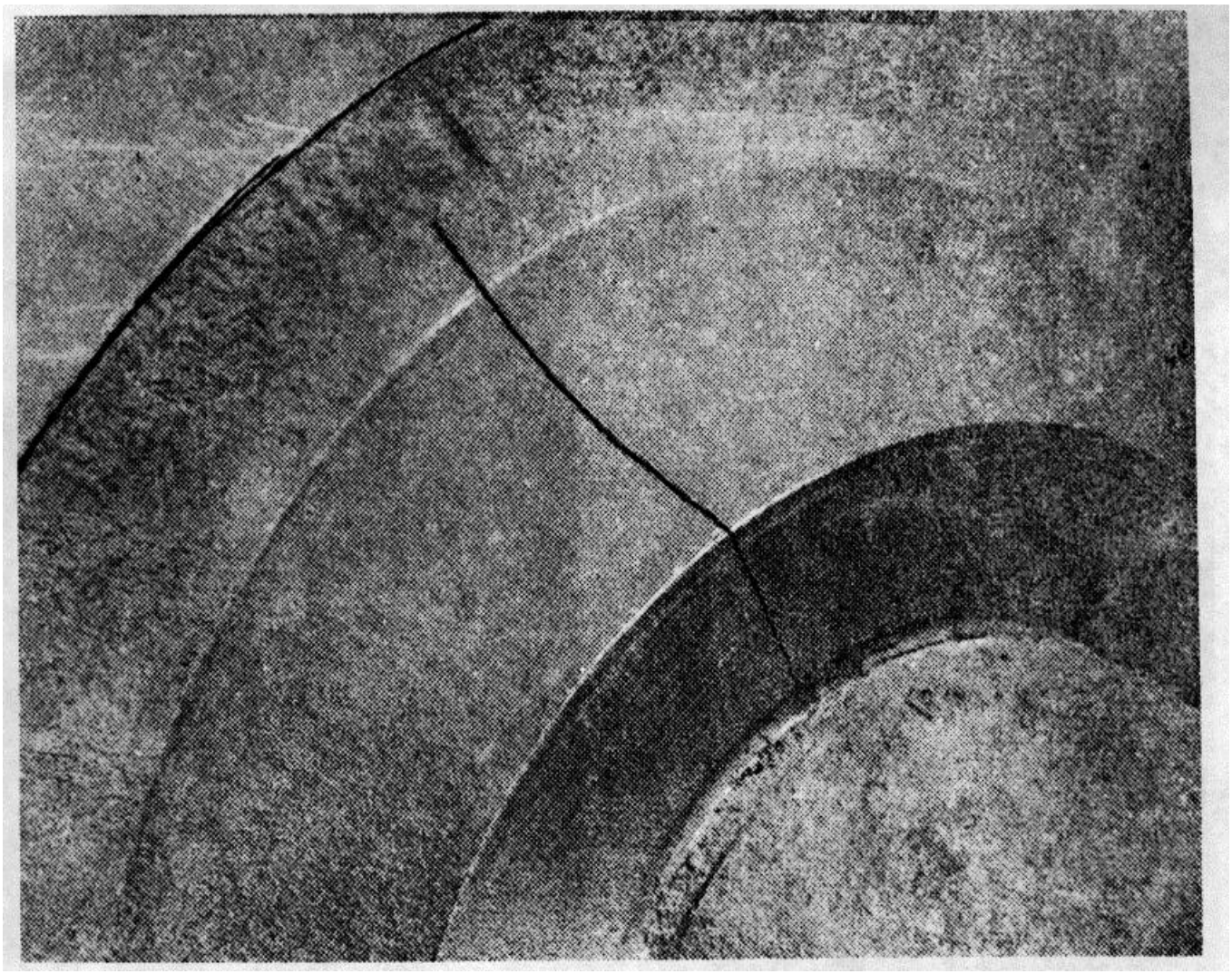


Figure 4-12. Cracked hub.

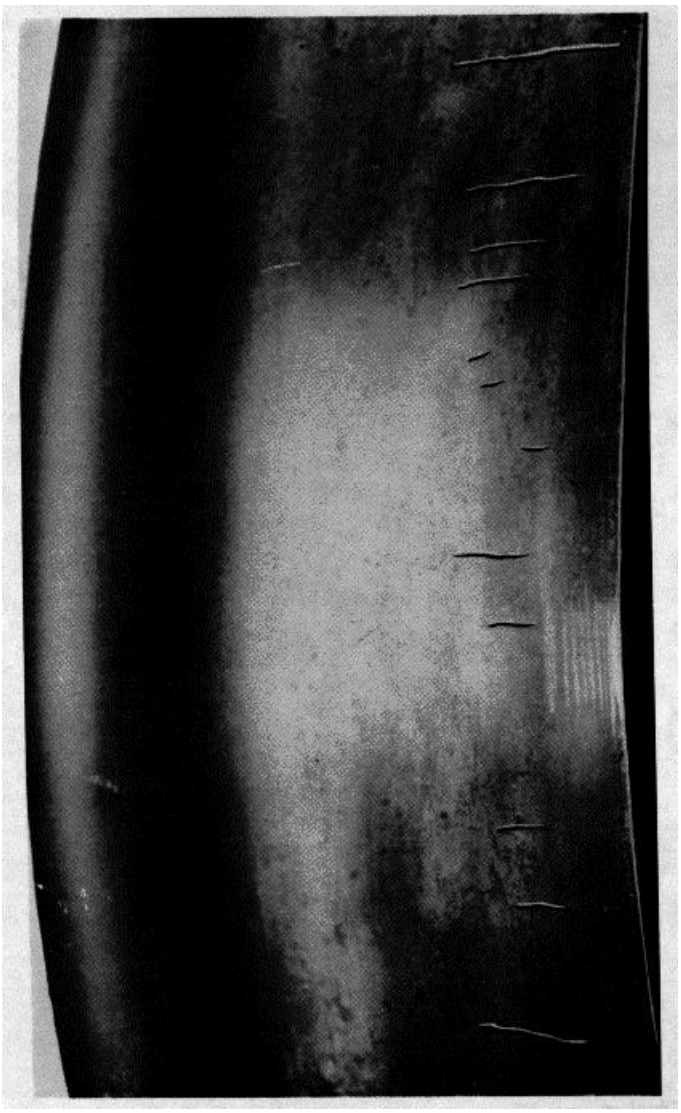


Figure 4-13. Thermal cracks.

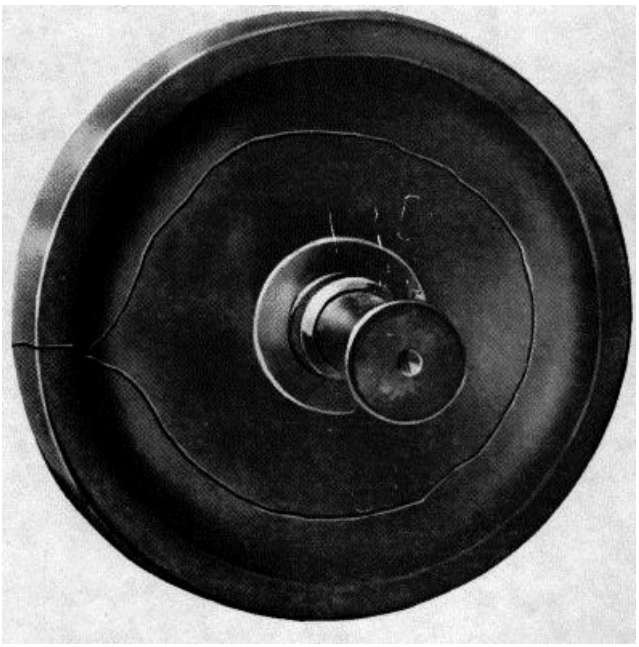


Figure 4-14(1). Cracked or broken plate.

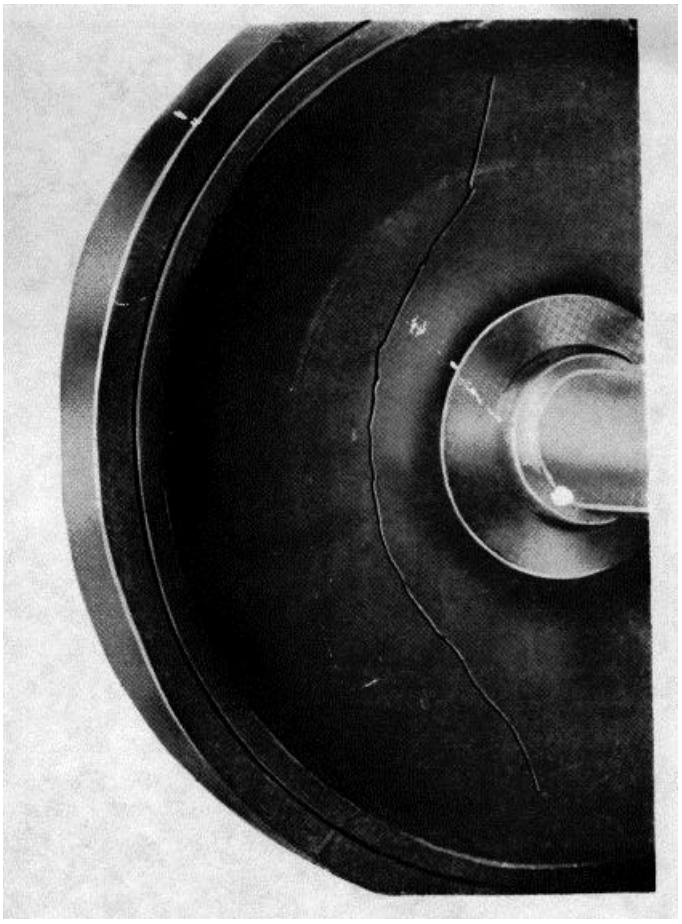


Figure 4-14(2). Crack extending through the rim.

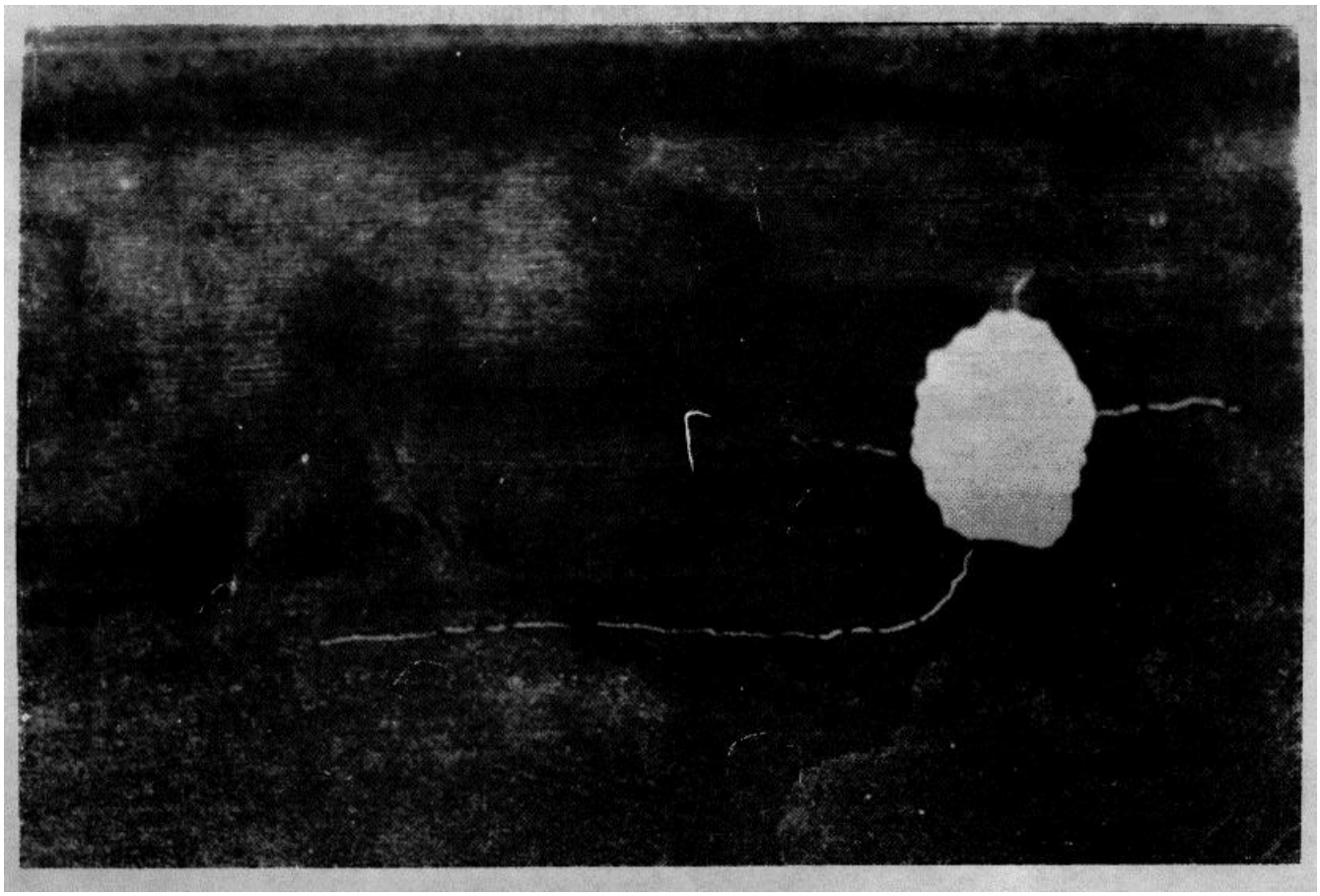


Figure 4-15. Crack originating from hole burned in wheel.

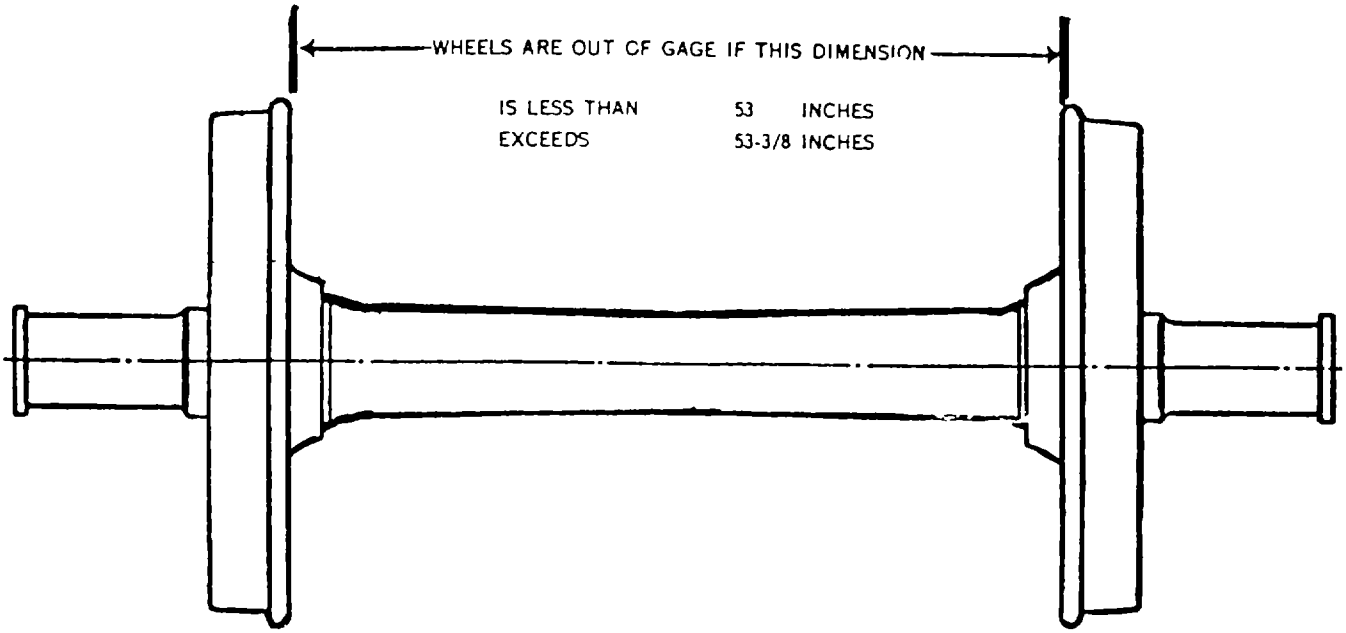


Figure 4-16. Method of gaging wheels.

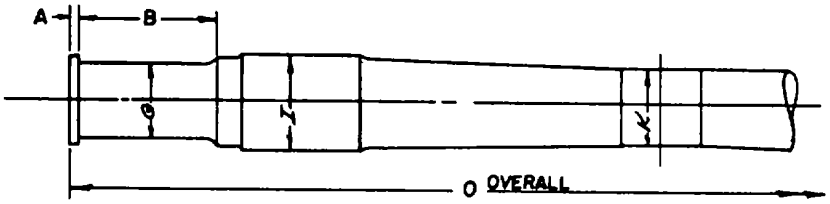
Section III. AXLES AND JOURNALS

4-7. Axles

a. The standards for axle design and dimensions are based on load ratings, which in turn are fixed by journal size. Figure 4-17 shows the limits of wear and the new dimensions for plain bearing freight-car axles, and figure 4-18 the same data for passenger-car axles. When new passenger-car axles are used on new cars in passenger car service, the load rating of the individual axles should be as shown in table 4-1. Wheels and axles are selected in accordance with the tables shown in figure 4-19.

Table 4-1. Axleload Ratings

AAR axle designation	Size of journal in inches	Load in pounds each axle is designed to carry	Maximum weight on railcar and load, four-wheel trucks, in pounds
A	3 3/4 × 7	15,000	66,000
B	4 1/4 × 8	24,000	103,000
C	5 × 9	33,500	142,000
D	5 1/2 × 10	42,000	177,000
E	6 × 11	52,500	220,000
F	6 1/2 × 12	63,000	263,000
G	7 × 12	76,000	315,000



		ROAD SERVICE LIMITS REQUIRING THE REMOVAL OF AXLE FROM SERVICE					SHOP LIMITS AXLES MUST NOT BE APPLIED UNDER FOREIGN EQUIPMENT IF NOT WITHIN THE FOLLOWING LIMITS.					DIMENSIONS NEW NOTE 1. "OVERSIZE" AXLES MAY BE 1/8" LARGER THAN SHOWN UNDER DIMENSION "I". NOTE 2 DIMENSION "O" MAY BE 1/8" GREATER THAN SHOWN BELOW.					
CLASSIFICATION OF AXLE	JOURNAL SIZE	WHEN REACHED		WHEN LESS THAN			IF GREATER THAN	WHEN LESS THAN									
		A	B	G	I	K	B	A	G	I	K	A	B	G	I	K	O
	INCHES	IN.	INS	INS	INS	INS.	INS	INS	INS.	INS.	INS.	INS	INS	INS	INS	INS.	FT. INS
B	4 1/4 x 8	3/16	8 11/16	3 3/4	6 1/16	4 11/16	8 2/16	1/4	3 7/8	6 1/16	4 11/16	5/8	8	4 1/4	6 5/16	4 3/4	7'-0 1/4"
C	5 x 9	3/16	9 11/16	4 1/2	6 3/4	5 1/4	9 2/16	1/4	4 5/8	6 3/4	5 1/4	3/4	9	5	7	5 3/8	7'-2 1/2"
D	5 1/2 x 10	3/16	10 11/16	5	7 3/16	5 3/4	10 2/16	1/4	5 1/8	7 5/16	5 3/4	3/4	10	5 1/2	7 7/16	5 7/8	7'-4 1/2"
E	6 x 11	3/16	11 11/16	5 1/2	8	6 5/16	11 2/16	1/4	5 3/8	8	6 5/16	7/8	11	6	8 1/4	6 7/16	7'-6 3/4"
F	6 1/2 x 12	3/16	12 11/16	6	8 1/2	6 3/4	12 2/16	1/4	6 1/8	8 1/2	6 3/4	7/8	12	6 1/2	8 3/4	7 3/8	7'-8 3/4"
G	7 x 12	3/16	12 11/16	6 1/2	9 1/4	7 7/8	12 2/16	1/4	6 5/8	9 1/4	7 7/8	7/8	12	7	9 1/2	8	7'-8 3/4"

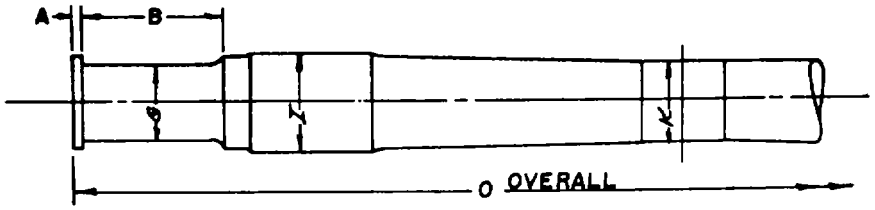
(Figure 2A.3 PB-AAR Wheel Manual)

Figure 4-17. New and limiting dimensions for plain bearing freight-car axles.

b. Common Defects. Cited below are short, general descriptions of various common axle and journal defects and recommended practices.

(1) *Cut or burnt journal.* A depression, continue-out streak, or an injury to the surface of the metal of wheel seats or journals, such as cut journal, must not be removed except by a machine cut in a lathe. Such a defeat, if allowed to remain, may cause a broken axle or a hot journal.

(2) *Bent axle.* All secondhand dismounted axles should be checked in the lathe or between centers for rotundity, concentricity, and taper of



CLASSIFICATION OF AXLE	JOURNAL SIZE	ROAD SERVICE LIMITS REQUIRING THE REMOVAL OF AXLE FROM SERVICE. WHEN REACHED A	WHEN REACHED B	WHEN LESS THAN G	WHEN LESS THAN I	WHEN LESS THAN K	SHOP LIMITS AXLES MUST NOT BE APPLIED IN PASSENGER SERVICE OR UNDER FOREIGN EQUIPMENT IF NOT WITHIN THE FOLLOWING LIMITS. IF GREATER THAN B	WHEN LESS THAN A	WHEN LESS THAN G	WHEN LESS THAN I	WHEN LESS THAN K	DIMENSIONS NEW NOTE 1. "OVERSIZE" AXLES MAY BE 1/8" LARGER THAN SHOWN UNDER DIMENSION "I". NOTE 2. DIMENSION "O" MAY BE 1/8" GREATER THAN SHOWN BELOW. A	B	G	I	K	O
	INCHES	IN.	INS.	INS	INS.	INS.	INS.	INS.	INS	INS	INS.	INS.	INS	INS.	INS.	INS.	FT. INS.
A	$3\frac{3}{4}$ x 7	$\frac{3}{16}$	$7\frac{9}{16}$	$3\frac{1}{4}$	$5\frac{1}{4}$	$4\frac{3}{16}$	$7\frac{7}{16}$	$\frac{1}{4}$	$3\frac{3}{8}$	$5\frac{1}{4}$	$4\frac{3}{16}$	$\frac{5}{8}$	7	$3\frac{3}{4}$	$5\frac{1}{2}$	$4\frac{1}{4}$	$6'-11\frac{1}{4}"$
B	$4\frac{1}{4}$ x 8	$\frac{3}{16}$	$8\frac{9}{16}$	$3\frac{3}{4}$	$6\frac{1}{16}$	$4\frac{11}{16}$	$8\frac{7}{16}$	$\frac{1}{4}$	$3\frac{7}{8}$	$6\frac{1}{16}$	$4\frac{11}{16}$	$\frac{5}{8}$	8	$4\frac{1}{4}$	$6\frac{5}{16}$	$4\frac{3}{4}$	$7'-0\frac{1}{4}"$
C	5 x 9	$\frac{3}{16}$	$9\frac{9}{16}$	$4\frac{1}{2}$	$6\frac{3}{4}$	$5\frac{1}{4}$	$9\frac{7}{16}$	$\frac{1}{4}$	$4\frac{5}{8}$	$6\frac{3}{4}$	$5\frac{1}{4}$	$\frac{3}{4}$	9	5	7	$5\frac{3}{8}$	$7'-2\frac{1}{2}"$
D	$5\frac{1}{2}$ x 10	$\frac{3}{16}$	$10\frac{9}{16}$	5	$7\frac{5}{16}$	$5\frac{3}{4}$	$10\frac{7}{16}$	$\frac{1}{4}$	$5\frac{1}{8}$	$7\frac{5}{16}$	$5\frac{3}{4}$	$\frac{3}{4}$	10	$5\frac{1}{2}$	$7\frac{9}{16}$	$5\frac{7}{8}$	$7'-4\frac{1}{2}"$
E	6 x 11	$\frac{3}{16}$	$11\frac{9}{16}$	$5\frac{1}{2}$	8	$6\frac{5}{16}$	$11\frac{7}{16}$	$\frac{1}{4}$	$5\frac{5}{8}$	8	$6\frac{5}{16}$	$\frac{7}{8}$	11	6	$8\frac{1}{4}$	$6\frac{7}{16}$	$7'-6\frac{3}{4}"$
F	$6\frac{1}{2}$ x 12	$\frac{3}{16}$	$12\frac{9}{16}$	6	$8\frac{1}{2}$	$6\frac{3}{4}$	$12\frac{7}{16}$	$\frac{1}{4}$	$6\frac{1}{8}$	$8\frac{1}{2}$	$6\frac{3}{4}$	$\frac{7}{8}$	12	$6\frac{1}{2}$	$8\frac{3}{4}$	$6\frac{7}{8}$	$7'-8\frac{3}{4}"$

NOTE.—This table does not apply to other axles used in passenger equipment cars which appear in Figure 2A.1PB.

Figure 2A.2 PB-AAR Wheel Manual)

New and Limiting Dimensions for Raised Wheel Seat (Standard 1940 Design) Plain Bearing Passenger Car Axles

Figure 4-13. New and limiting dimensions for plain bearing passenger-car axles.

wheel seats and journals. If an axle is found to be bent, it should be scrapped unless the journals and wheel seats can be trued up within, the specified limits. A practice sometimes followed is to leave a chalk witness mark around the wheel seats to show that the axle has been checked in the lathe.

(3) *Broken axle.* Circumferential laps or seams in any portion of the axle are likely to cause trouble. A broken axle or one with a broken end collar must be scrapped.

(4) *Back journal fillet.* To standardize lathe tools and simplify shop practices, journal fillets normally are turned to the standard radii for new axles. The rules, however, permit the use of secondhand axles with minimum back fillet radius of 1/8 inch for C and larger axles which can be gaged with the wheel-defect gage. This minimum radius should be employed only when axles can, be reapplied without refinishing or when restoring the fillets to standard radii would cause the journal to be scrapped for a deficiency in length or diameter.

(5) *Journal length worn to limit.* The length of worn journals should be measured from a ,point 1/4 inch above the journal surface on the face of the end collar to a point 1/8 inch below the dust-guard seat on the back fillet, as shown in figure 4-20. Any gage which measures the length of journals in accordance with this method can be used. Figure 4-21 illustrates the type of gage used on railroads throughout the United States.

(6) *Collar worn to limit.* Limits of wear will conform to those shown in figure 4-18.

(7) *Journal diameter worn below limits.* Limits of wear will conform to those shown in figure 4-18.

(8) *Wheel seat below limit.* Limits of wear will conform to those shown in figure 4-18.

(9) *Journal length worn to limit.* Axles usually are scrapped because the journals have reached the condemning length rather than because the journal or wheel seats have reached the condemning diameter. In theaters of operations where axles may be in short supply, a light 1/8-inch cut off the diameter of the journal will remove average scores or cuts in the fillets or restore worn fillets without lengthening the journal appreciably or reducing the thickness of the end collar.

CLASS OF AXLE	A	B	C	D	E	F
Journal dimensions, new	3 3/4x7"	4 1/4x8"	5x9"	5 1/2x10"	6x11"	6 1/2x12"
Load in pounds each axle is designed to carry	15,000	24,000	32,000	40,000	50,000	60,000
Nominal capacity of car based on four-wheel trucks	40,000	60,000	80,000	100,000	140,000	200,000
Maximum weight on rail of car and load based on four-wheel trucks	66,000	103,000	142,000	177,000	220,000	263,000
1. New axles should be applied in second-hand wheels, the axle wheel-seats to be turned to a finished diameter of approximately	5 3/16"	5 13/16"	6 9/16"	7 1/16"	7 11/16"	8 3/16"
2. When new axles must be applied in new wheels, the axle wheel seats should be turned to a compromise diameter of	5 1/8"	5 3/4"	6 1/2"	7"	7 5/8"	8 1/8"
3. When the bore of usable old wheels has reached the maximum diameter shown in Item 1, above, they may be reapplied to "Oversized" axles with wheel seats turned to a finished diameter not more than	5 1/4"	5 7/8"	6 5/8"	7 1/8"	7 3/4"	8 1/4"
4. The wheel seats of old axles may be turned to a minimum finished diameter of	4 7/8"	5 1/2"	6 1/4"	6 3/4"	7 3/8"	7 7/8"

Figure 4-19. Economical selection of wheels and axles.

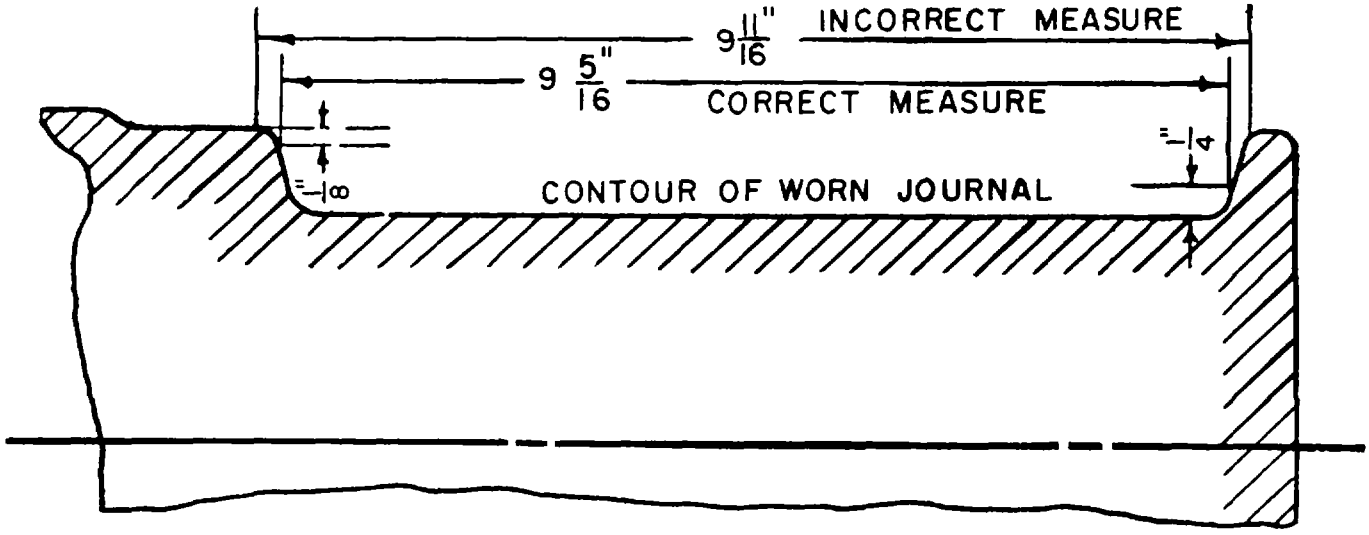


Figure 4-20. Length of worn journal.

4-8. Journal Box and Assembly

a. General. The journal box contains the bearing and wedge assembly, the axle journal, and necessary waste packing or lubricating pads and lubricant (fig 4-22). The journal -box dust guard ,and plug are inserted in a vertical slot in the back end of the box. The plug provides a close fit with the turned axle dust-guard seat to prevent cinders, dirt, or moisture from entering the box from the back) a condition that might otherwise increase wear on the journal or bearing and possibly eventually cause a hot journal. The dust guard is inserted in place before the journal box is fitted over the journal.

b. Bearing. The journal bearing serves the same purpose as all other bearings. Its distinguishing feature is its unusual top bearing function in contrast to the usual lower or all-round bearing so often encountered in machine construction. If affords a tough, solid wearing surface at the point of contact, where the weight of the car is transferred to the journal. Since it is necessary to replace these bearings frequently, they are designed to be removed easily. They are

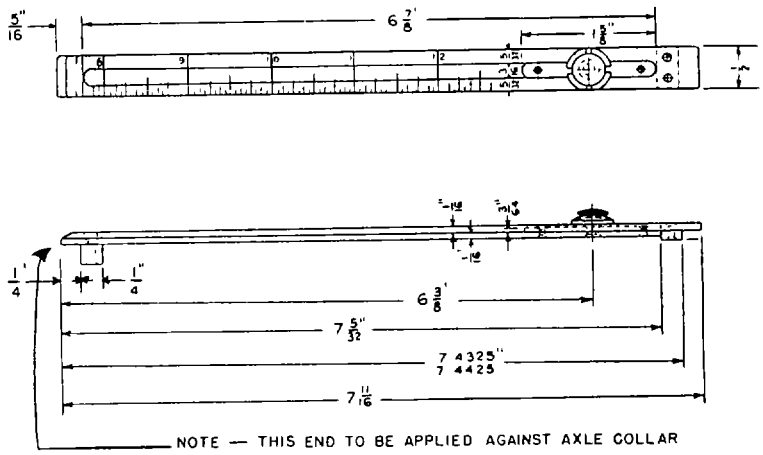


Figure 4-21. Gage to be used in measuring length of worn journals on class A to F axles, inclusive.

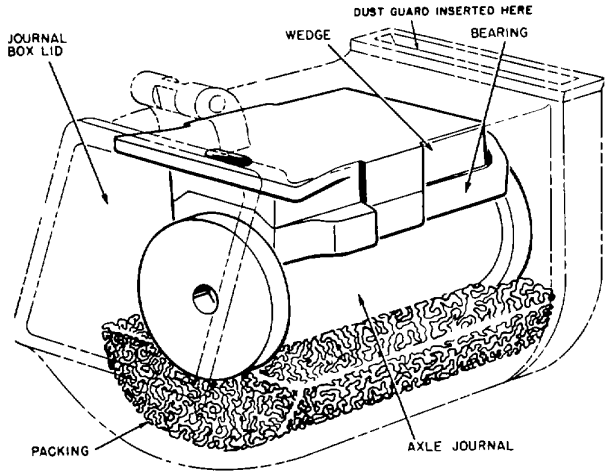


Figure 4-22. Typical journal box assembly.

built to meet specifications and are fabricated of either bronze or a .special iron. They are also provided with a babbitt metal lining, which is poured cast to face the bearing back and become an integral part of it. This combination of metals has long been considered the best for solid-bearing construction. The babbit is soft, although tough and durable, and provides a highly efficient bearing surface. The iron or bronze backing in turn gives support and tends to dissipate the heat generated by transferring it to the box top.

c. Wedge. The wedge, a companion part of the bearing assembly, is provided to furnish limited rocker anchorage for the bearing It also serves to distribute the weight of the car equally over the wear surface of the bearing because of its rocker-bearing contour. The wedge is held in place by projections provided for this purpose in the cast-steel journal box top The lugs are released when the journal box is jacked up a few inches.

d. Journal Box. The journal box packing contained in the journal box bottom is an important part of the bearing assembly Whether it consists of commercial spring-type lubricating pads or cotton and/or wool waste, when packed in the prescribed manner, it acts as a wick and feeds lubricant to the bearing. The use of waste packing has been discontinued on most commercial railroads in the continental United States (CONUS), present practice being to use AAR-approved lubricator pads. There is increasing use of the roller bearing journals for freight service also. Most Department of the Army (DA)-owned rolling stock overseas has the waste-type journals. Details concerning proper packing of journal boxes are contained in paragraphs 4-12 through 4-18.

e. Box Lid. The journal box lid closes the front of the journal box and keeps out dust, dirt, and other foreign matter detrimental to the operation of the journal bearing. Although the lid is hung so that it will remain closed during movement of the car, it is made to open easily for servicing and inspection. The lid is hinged from the top of the box and is spring-loaded to insure tight closure. An attachment is provided to keep the lid open when servicing operations are in progress. On oversea cars, bolt-locked journal box lids are standardized to minimize pilferage of waste and brass journal bearings.

f. Roller Bearings. These are being used to a great extent worldwide for both passenger and freight cars. They require relatively little maintenance attention beyond periodic relubrication. Additional advantages are almost total elimination

of "hot-box" problems, better riding qualities for the car, and lessened wheel and truck wear. Roller bearings are manufactured by various commercial concerns in CONUS of two general types-cylindrical and tapered hard steel bearings fitted snugly to the axle journal. The tapered bearing is illustrated in figure 4-23(1). The component parts of another bearing are shown in figures 4-23(2) and 4-23(3).

4-9. Causes of Hotboxes

a. Waste Grab. Threads or particles of waste between the bearing and the journal act as an oil wipe and cause a dry spot. Waste grab may be caused by loose threads and lint wedging (a waste grab) between the bearing and journal. Loose threads must be tucked under, and packing must be free from lint. Wedging is most likely when a standard size bearing is applied to a minimum size journal or one which is worn close to the limit. Packing which is rolled up on one side of the box is an invitation to waste grab. Rough handling in yards or severe buffing shocks in trains may cause displacement of the bearing on the journal for an instant, long enough for bits of waste to get under the bearing. The method of detecting waste grab is to feel along the edge of the bearing with the waste grab hook (fig 4-24).

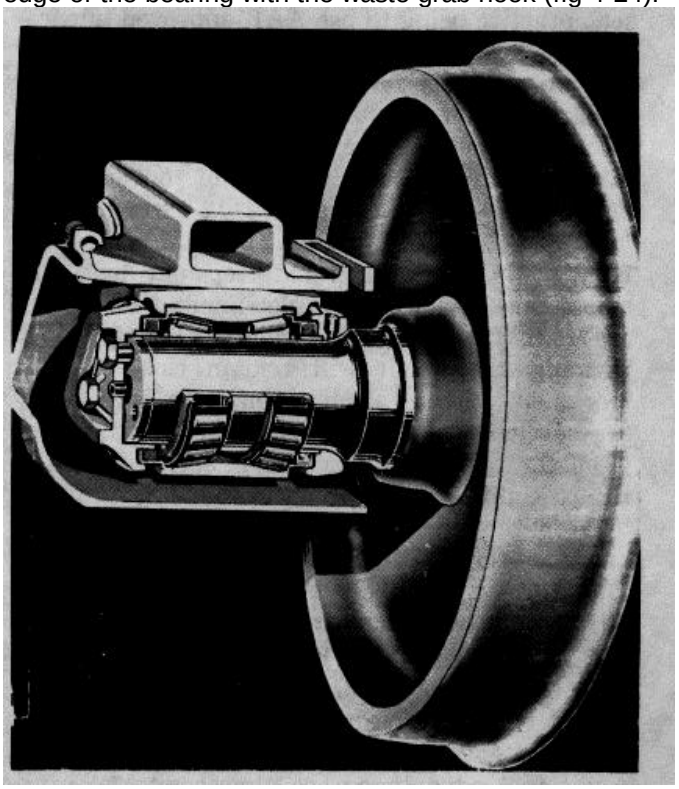


Figure 4-23(1). Tapered roller bearing.

b. Dry or Misplaced Packing. If the packing has settled away from the journal for any portion of its length or if the back roll is not in contact with the journal fillet, a dry spot develops and overheating results. The accepted method of 'detecting misplaced packling is examination with the standard packing iron or packing hook (fig 4-24). Dry packing is corrected by adding free oil. However, too much oil makes the packing soggy and causes thread and lint to stick to a cold journal.

c. Loose or Overrun Lining. If the bearing lining is overrun, it interferes with the proper oil circulation and prevents oil from following the journal into the load-bearing area. Loose or overrun lining can be detected with the lining or waste grab hook when checking for waste grab.

d. Water in Packing. In freezing weather, water freezes in the waste threads and shuts off the capillary action which carries oil to the journal. It may cause the packing to adhere to the journal and become badly misplaced. Water also gets under the oil when it does not freeze and displaces oil from the back of the box through the dust-guard well. Loose or poorly fitting lids admit snow and cause water trouble.

e. Dripping Brine. Brine dripping from refrigerator cars causes trouble if it enters the journal box. It is corrosive and can cause rough spots on journals.

f. Flat or Rough Wheels. Flat or rough wheels cause a pounding which settles the packing away from the journal and breaks the oil film under the bearing.

g. Overloaded Cars. Common causes of hotboxes are overloaded cars, or cars having misplaced or shifted lading which increases the load on one or more journal boxes.

h. Defective Trucks. Trucks which are out of square or which do not swivel freely owing to binding of side bearings or dry center plates may contribute to overheated bearings.

i. Axles. Bent axles may cause hotboxes. If an axle is bent between wheels, the wheel tread will show uneven wear. Bearings on bent axles will also show tapered wear, and if allowed to continue in service may become badly damaged by overheating. The bearing on the other end of the axle should be examined as a precaution if a bent axle is suspected.

j. Truck Bolster Springs and Snubbing Devices. Defective or improperly applied coil springs and snubbing devices may result in hotboxes.

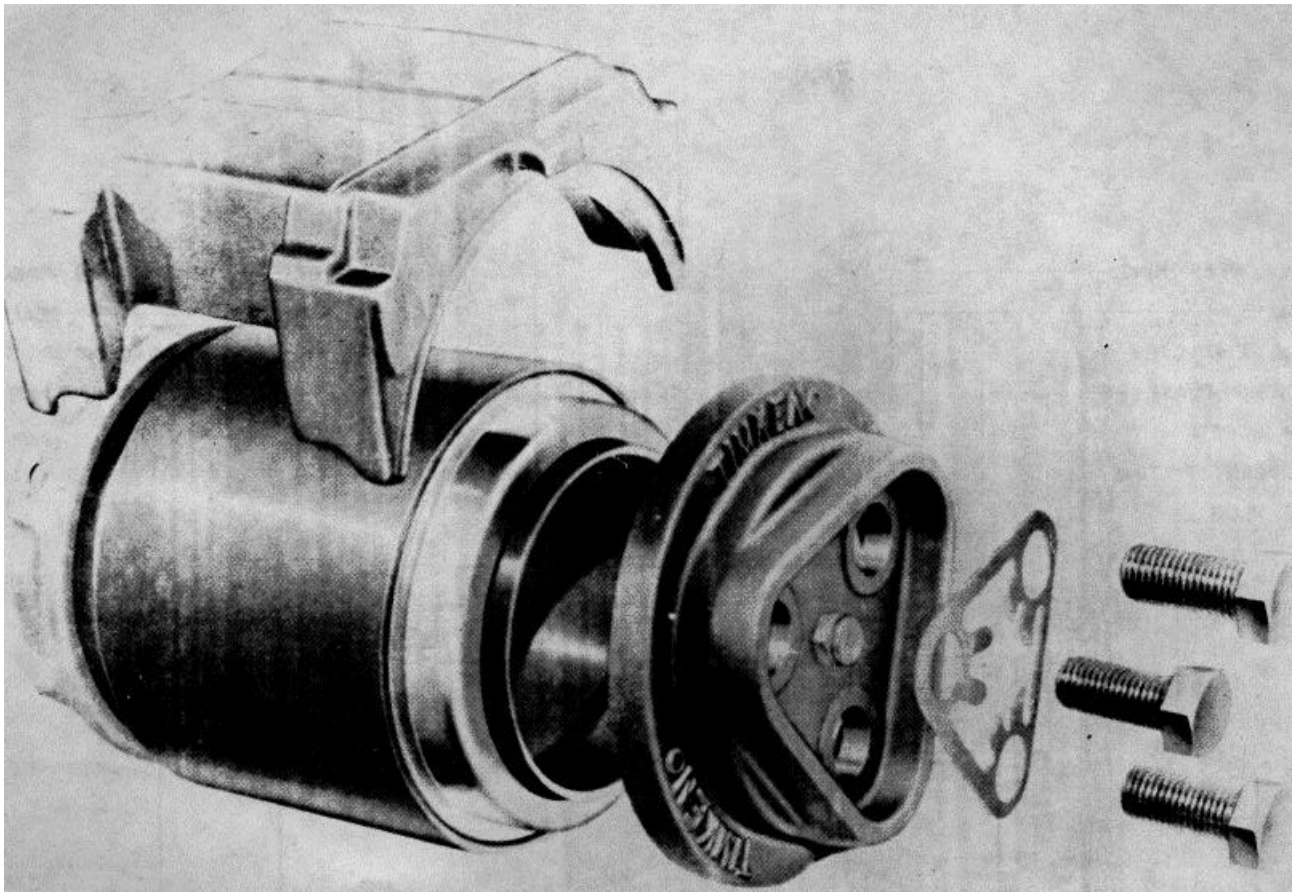


Figure 4-23(2). Heavy duty bearing assembly, application parts, exploded view.

4-10. Journal Care

Overheating (hotboxes) causes the oil in the journal box to carbonize or burn. After the oil in the packing has burned, the remaining black residue sticks to the journal bearing and scratches or cuts the journal, which is relatively soft when hot. A "rough" journal can be detected by feel, either by using the tips of the fingers, or preferably by using the pointed end of a waste grab hook (fig. 4-24). It will also be very dry. When a journal becomes scarred, it is unsafe for further service and that pair of wheels will be replaced.

4-11. Journal Bearings

a. General. Like the journal, the main cause of journal bearing failure can be traced to the lack of lubrication Bearing damage will occur when there is not enough oil on the journal to overcome the effects of friction developed between the journal and bearing, whether babbitt lined brass or steel roller bearing If one end of the bearing is excessively worn, the journal should be examined for tapering. Tapering is caused by uneven weight distribution plus faulty lubrication. Wear marks will indicate whether the journal will become tapered or not.

b. Renewal Precautions. In the process of changing wheels and/or applying new journal bearings to car wheels, the following precautions will be observed.

(1) The surface of the journal should be smooth and thoroughly clean before the bearing is applied. Abrasive paper or cloth should not be used on or about axle journals under cars. Journal surfaces should not be wiped with waste.

(2) Plain journal bearings should be clean and smooth before application. Do not use abrasive paper or cloth for removing irregularities If necessary use a half-round file or scraper.

(3) Apply a thin coat or car oil to the lining before applying a bearing. *Never wipe the lining or journal with waste.*

Nomenclature

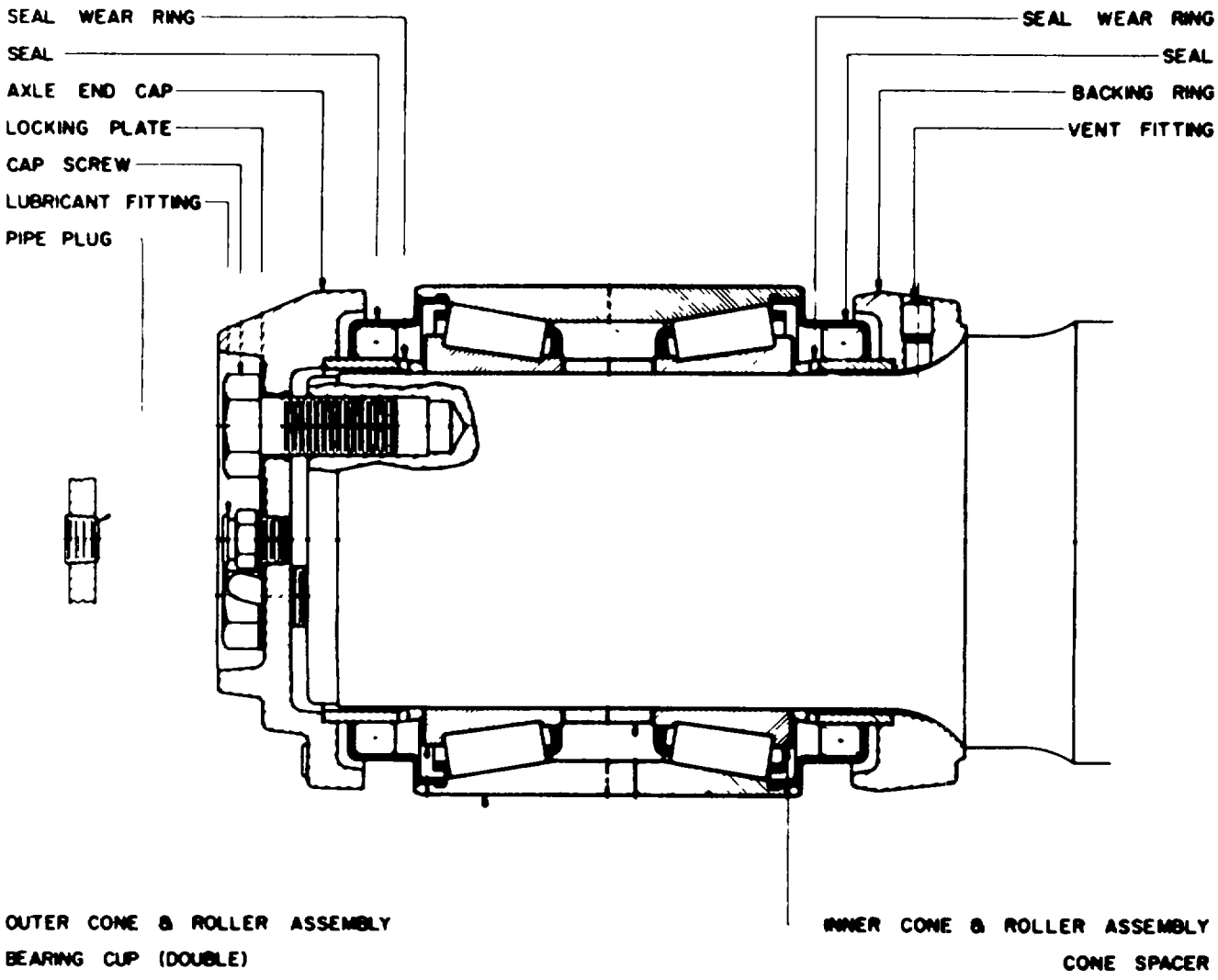


Figure 4-23(3). Nomenclature, heavy-duty bearing assembly.

(4) Renew journal bearings when:

(a) Back lug is broken or cracked.

(b) Worn 1/4 inch or more lengthwise at either end.

(c) Combined wear lengthwise is 3/8 inch or more.

(d) Lug worn to a depth 1/8 inch or more in area which is over 50 percent of contact face.

(e) Combined wear, on both sides of lug extension is 1/4 inch or more at any location.

(f) Lining is worn through to brass at any location 3/8 inch or more above the lower edge of brass side walls.

(g) Lining is loose or broken out.

(h) Lining is pulled in journal contact area (indicated by wear pattern).

(i) Wheels and axles are changed (2 bearings for each set of wheels).

(j) Missing.

c. Method of Removal. To remove a journal bearing the journal packing should first be removed

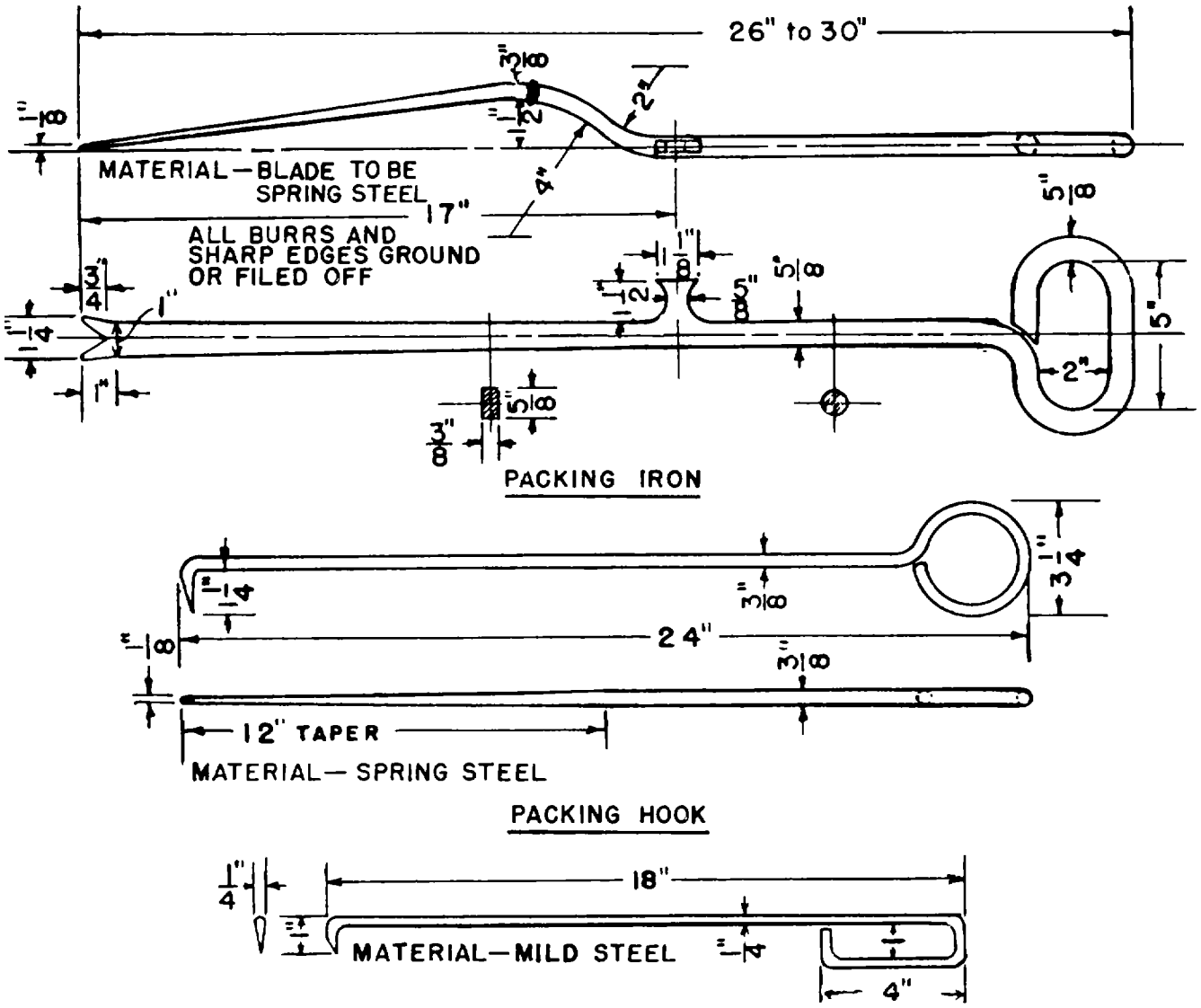


Figure 4-24. Packing iron and waste grab hook.

moved from the journal box. Suitable size journal jacks should be placed under both journal boxes The one at the opposite end from which the bearing is to be removed will merely be raised to contact the bottom of the journal box to counterbalance and minimize the jacking action In the other end. If only one jack is available, the wheel may be blocked by suitable size blocks placed between wheel tread and car frame. Jack under journal box from which the bearing is to be removed will be raised until the wedge over the bearing will slide free. The wedge and then the bearing will be carefully removed by using packing hooks. Car repairmen or inspectors *will not* insert their fingers or hands between the wedge, journal, or journal box top. Reverse procedure will be used for placing new bearing. It will be placed part way in the box by hand, pushed over the journal collar into place with a packing hook, wedge inserted in the same manner, jacks lowered and removed, and journal box packing replaced.

d. Handling. Journal bearings, whether new, relined, or broached, should be handled with the same care and attention as finished machine parts. The lining is relatively soft and easily damaged by abrasion or impact. Railway car repairmen and supply personnel handling the journal bearings will be guided by the following general policies.

(1) Bearings with loose, thin, or spread lining, but within dimensional limits of standard specifications, may be reclaimed by relining.

(2) If journal bearings removed in wheel changes or taken from dismantled cars are within dimensional limits, they may be reclaimed by boring or broaching, provided that not less than 1/8

inch of lining metal remains. Such bearings should be tested for loose lining after broaching. This is done by standing the bearing on end and tapping it with a hammer If the lining is tight, the bearing will have a clear, metallic ring Journal bearings should be selected for broaching by proper inspecting and by use of appropriate gages.

(3) Bearings with lining melted off from overheating in service should not be relined.

(4) When wheels are removed to be turned and when it is feasible to do so, it is good practice to return bearings to service with the same journals, provided they are within dimensional limits and linings are tight.

(5) Bearings should not be thrown or dropped or allowed to lie around mixed with other material.

(6) In transit and in storage, bearings should be stowed or stacked to avoid damage to lining. An approved method of stacking bearings is shown in figure 4-25. Bearings may also be stacked in layers with wood or scrap sheet metal between layers.

e. Journal Bearing Wedges. New wedges should conform to the dimensional limits of current regulations. Each wedge should be checked out of the bearing and should seat properly on the crown, without pinching the sides or resting on the lugs. If the front surface of the wedge is bent down, it will not engage the lugs in the box. Sometimes wedges are too narrow for the bearing; this will tend to pinch the journal and may ,cause a hotbox. If the wedge is flat on top, it cannot rock with the rotation of the axle as intended. The weight will be unevenly distributed over the bearing, and too much weight in one place will cause sufficient friction to make the journal run hot. If the wedge exhibits a bright ridge over its entire length on top, it is reasonably sure that the wedge is not rocking, but is bearing rigidly against the top of the journal box. The following general rules apply:

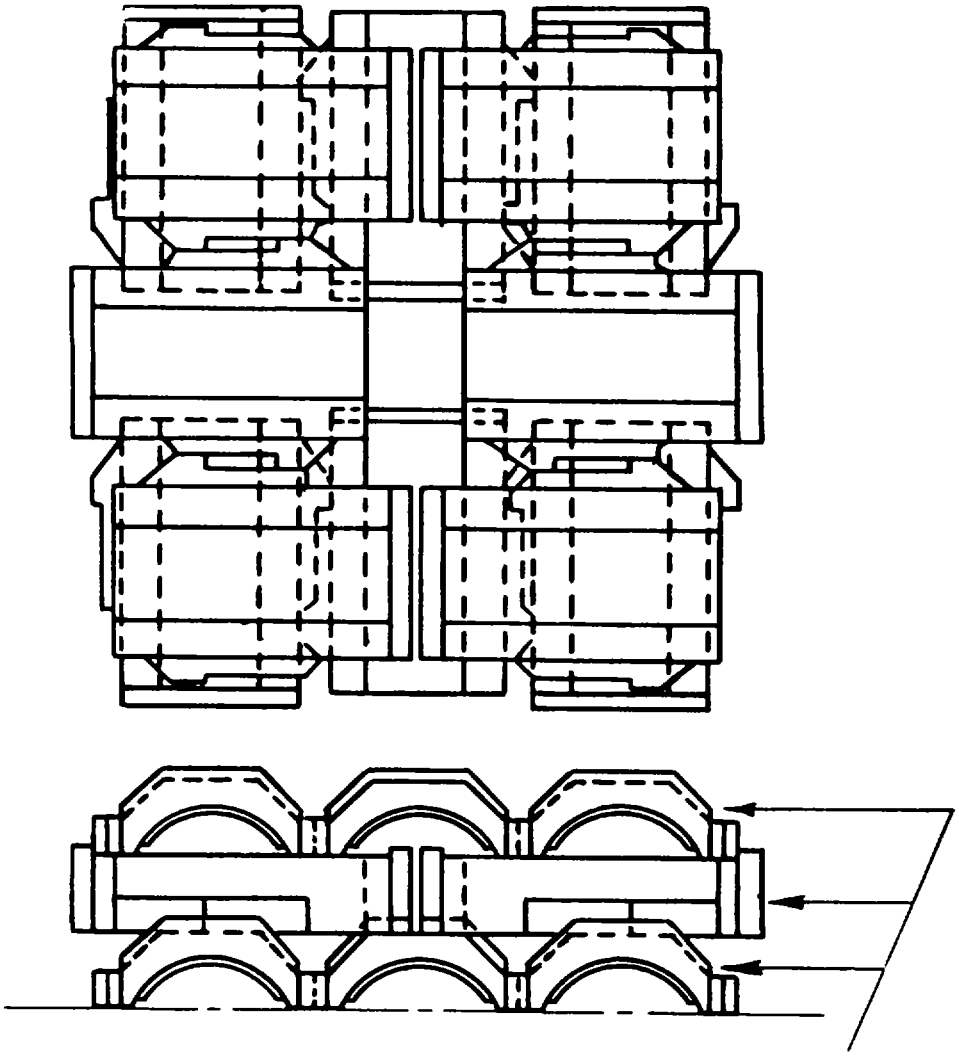


Figure 4-25. Recommended method of stacking journal bearings.

(1) Wedges cracked, distorted, or broken should not be reapplied.

(2) Wedges flat on top for a length exceeding the original diameter of the journal should not be reapplied. Wear limits are indicated in the following table.

Table 4-2. Journal Wear Limits

Normal journal size (in.)	*Wear limit flat-lengthwise (in.)*
4 1/4 x 8	3 1/4
5 x 9	4
5 1/2 x 10	4 1/2
6 x 1	5
6 1/2 x 12	65 1/2

(3) Wedges having the overall length reduced more than three-sixteenths of an inch at contact surfaces should not be reapplied.

(4) If bottom of bearing surface of wedge is uneven to the extent of 1/64 of an inch, as determined by a straightedge or suitable gage, wedge must be removed from service.

f. Dust Guards. Whenever wheels are changed, the dust guards also should be renewed.

Section IV. JOURNAL BOX LUBRICATION

4-12. Journal Packing

a. General. Lubrication failures which result in overheated journal bearings (hotboxes) cause serious delay in railway operations. Trains are delayed because of the necessity of attending to, or setting out cars with hotboxes. This results in delays and interference with other train movements. Hotboxes not detected in time may result in journals burning off and consequent derailments. Car journals may be packed with oil-soaked waste (fig 4-26) or AAR-approved mechanical lubricating devices (fig 4-27). These devices consist of oil-soaked pads held against car journals be retainer springs. AAR Interchange Rules, applicable In CONUS, state that "-journal lubricating devices, AAR-approved types, conditionally approved types, or types authorized for limited test application are required on all cars having plain bearings in interchange."

b. Packing Adjustment. Journal packing may appear in good condition on first examination; however, car inspectors should make a thorough Inspection by use of the packing hook (para 4-9a). The packing hook should be pushed under lone side of the Journal as far as it will go, and out-of-place packing turned and adjusted to provide a new bearing surface. When packing is left too long without this adjustment, the part that bears on the journal becomes glazed as the turning journal presses against it. Dust and dirt tend to accumulate at this point and contribute to journal wear. These conditions reduce or stop the oil flow to the journal and may cause it to become overheated, i.e., a hotbox.

4-13. Inspection of Journal Packing

a. General. When inspection reveals any of the following conditions, action will be taken as indicated below.

(1) If the journal packing is dirty or mixed with grease, the box should be repacked.

(2) Journal boxes containing excessive amounts -of snow, ice, or water should be repacked. Particular attention should be given to all boxes located under drains of ice bunkers or refrigerator cars. When found to contain drippings, the boxes should be repacked.

(3) Journal boxes that have been in high water should be cleaned and repacked as soon as practicable; careful examination must be made.

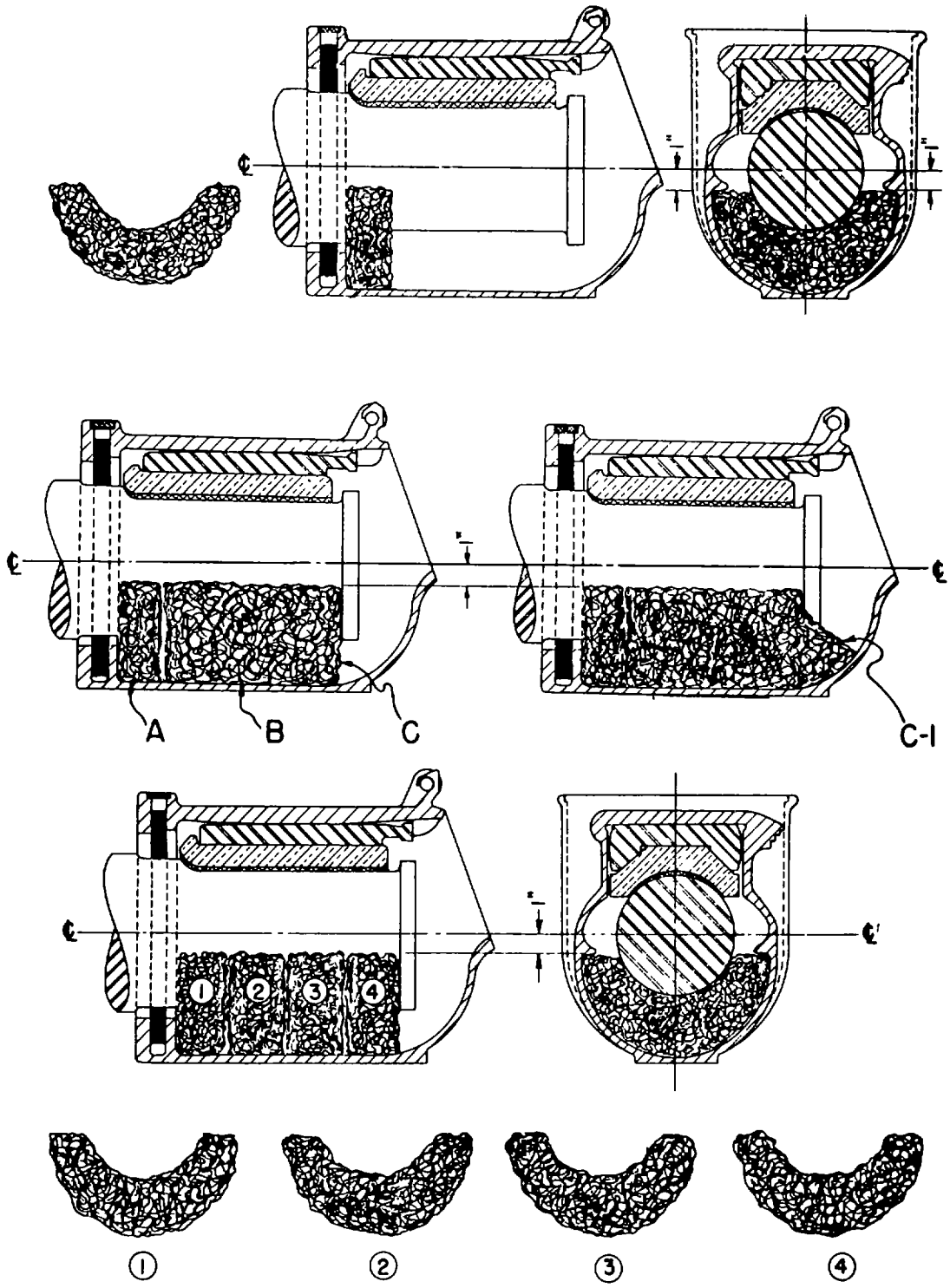
for corroded or pitted journals.

b. Reoiling. If packing shows dry along the -top after having been reset or if there is less than 1/2 inch of oil in the bottom of box, oil should ,be added, starting at the back of the box and working the oil can spout forward along both sides of the journal. If the direction of car movement is known, oil should be added on the rising side of the journal only. The box lid must close properly, and there must be no loose threads of packing hanging outside. If it is necessary In cold weather to add cutback or thinner oil, hot car oil or thin oil having a flashpoint of 300° F. or above may be used The use of kerosene oil or any oil with a flashpoint below 300° F. is prohibited.

4-14. Preparation and Handling of Packing Materials

a. Packing must consist of all new, all renovated, or a blended mixture of new and renovated waste or lubricating pads as determined by the requirements of the service for which it is to be used.

b. The waste should be loosened and shaken out thoroughly and then placed in a saturating vat. The waste should be completely submerged 'in oil (temperature of the oil not less than 70° F.) for a period of not less than 48 hours to insure


A
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LOOSE WASTE SHALL BE MATTED TOGETHER INTO ROLLS, NUMBER OF ROLLS PER BOX OPTIONAL LAST ROLL APPLIED SHOULD BE LARGE ENOUGH TO FILL OUT WITHOUT USING SMALLER PIECE. WHEN APPLYING ROLLS, ALL LOOSE ENDS TO BE TUCKED UNDER.

Figure 4-26. Method of packing journal boxes.

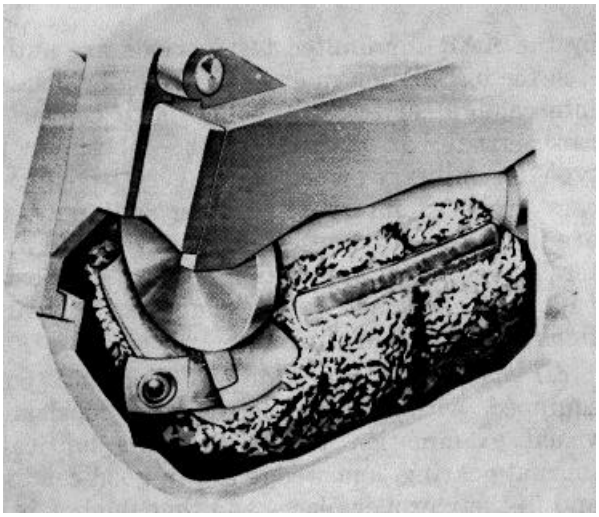


Figure 4-27. Typical lubricator pad.

thorough saturation of the threads. To remove the excess oil, it should be drained on a rack until the packing is resilient or elastic. Oil should not drip from drained packing when lifted from the drain rack, but oil should flow from drained packing squeezed in the hand.

c. When prepared packing is shipped, drums or containers capable of excluding water, dust, and foreign matter should be used. When such containers are used for return shipments of old packing, they should be thoroughly cleaned before being refilled.

d. Prepared packing stored in shipping containers awaiting use should be protected with tight-fitting lids to prevent contamination.

e. Prepared packing in tanks, vats, or other containers should be turned over or the accumulated oil in the bottom drawn off and poured over the top at least once in each 4 hours during working hours.

4-15. Preparation for Packing Journal Boxes

a. Before packing a journal box, the interior, including the journal, bearing, and wedge, must be thoroughly cleaned. The front of the box, which may come in contact with the packing being applied, and the inside of the lid must also be cleaned.

b. When applying new boxes or reapplying boxes, the dust-guard well should also be cleaned as above.

c. Boxes should be inspected for cracks which might cause oil leakage.

d. Journal box rear seals or close-fitting dust guards, dust-guard plugs, and box lids complying with specifications should be applied.

4-16. Packing Journal Boxes (Waste)

a. All reclaimable packing removed from journal boxes should be pulled directly into containers, avoiding contact with the ground or any other place where it may pick up dirt. Large, loose pieces of lining, grease, or foreign matter should be removed. The packing should then be taken promptly to the waste plant or the central shipping point. It should be kept under cover to protect it from weather, dust, or dirt, and to exclude water. Removed packing must not be reused until it has been renovated. When reclaimed packing is insufficient for requirements, new waste should be added and thoroughly blended to form a uniform mixture.

b. Back rolls consisting of light-twisted prepared packing with ends turned under, or of suitable size to fill the space between the journal and the journal box, should be inserted and worked back under the journal to the extreme back of the box as shown in the top row of figure 4-26. The length of the roll should suit the diameter of the journal, and the ends must be approximately 1 Inch below the centerline of the journal. The roll must be well up against the journal so as to properly lubricate the journal fillet and to keep out dust and dirt Rolls tied with twine should not be used.

c. Sufficient packing is applied in one piece (B, fig 4-26) or in rolls (A, fig 4-26) to firmly fill the space under the journal and to bear evenly along the length of the journal to prevent settling away. Care must be taken to have the 'packing bear evenly along the full length of the lower side of the journal. Boxes equipped with a spring-type packing retainer device must have packing at front, finished off, straight down from the inside face of the journal collar (C, fig 4-26) Boxes not equipped with a packing retainer device must have packing at the front finished off on a downward Incline (C-I, fig 4- 26).

d. For the one-piece or bulk method, after the back roll has been applied, with the packing bucket directly under the box, the packing is placed across the full width of the mouth of the journal box and the strands allowed to hang outside. More packing must always be added before the hanging strands are placed inside the box This has the effect of binding all of the body of the packing together The top of the packing along the sides must be approximately 1 inch below the centerline of the journal.

e. For the roll method, lightly twisted rolls of prepared packing with the ends turned under, or suitable size to fill the space between journal and journal box, are used to fill up the box as shown in the bottom row of figure 4-26. The back roll (1) and the additional rolls marked (2), (3), and (4) are prepared and inserted In the same manner from the back roll to the inner or back face of the journal collar. No loose ends of threads should protrude at sides or ends, and any loose ends or threads should be carefully tucked under the sides of the packing. The number of rolls per box is optional. When the box has been serviced the level of packing on each side should be approximately 1 inch below the centerline of the journal. Packing should be added or removed if necessary to produce this condition.

f. Oil should be added to such boxes as do not appear to contain sufficient oil after packing. There should be approximately 1 inch of oil in the bottom of the box in front of the journal collar. Too much oil causes soggy packing and results in oil being thrown out of back of the box. Lubrication is adequate if oil shows between the fingers when a handful of waste is squeezed.

g. Journal boxes equipped with approved spring-type packing retainer devices should be packed more firmly than those without such devices to insure that both packing and retainer will stay in proper position.

4-17. Packing Journal Boxes (Lubricator Pads)

a. General. All oil waste packing or damaged or worn lubricator devices will be removed from the journal box. Journal bearings and journal box will be cleaned and inspected as prescribed in paragraph 4-15. Apply journal lubricator in accordance with manufacturer's instructions provided in each lubricator shipping container. Rail- way car oil (VV-L822) will be used to saturate the pad and for subsequent replenishing. When necessary to replace all lubricating devices in a car at the same time, all devices applied must be of the same kind. Refer to the current issue of the AAR Interchange Rules for complete listing of AAR "approved," "conditionally approved," and "approved for test."

b. Typical Pads. Figure 4-27 depicts a typical lubricating pad, constructed of chenilled cotton fabric. Lubrication is provided by wicking action. It has one continuous pull strap extending out at each end fitted with brass grommets for ease of adjustment and removal from box. Only those types of lubricating pads which have been conditionally approved, finally approved, or approved by the AAR for limited test periods are authorized for installation in any car journal which is in interchange service. DA policy is to convert all car journal box packing to the lubricator pad type on military-owned cars, even though the cars are used interpost or interplant only, and are not offered to any commercial railroad in interchange. Initial application of these lubricating pads is to be made in accordance with instructions of the manufacturer.

c. Inspection. Inspection of journal boxes equipped with lubricating devices consists of visual examination to see that the lubricator, journal bearing, and wedge are in good condition and in their proper places and that the box is not overheating. No servicing or setting up with a packing iron is required unless the lubricator is shifted in the box, in which case it should be adjusted to the proper position. Journal box packing (waste) *will not* be used with these devices.

d. Cause for Renewal. Journal lubricating devices will be considered as defective and requiring renewal when:

(1) There is any noncontact with journal.

(2) There is any scorched or burnt area.

(3) There is any glazing of the surface which contacts the journal.

(4) Top, front, back, or side is torn for more than 1/2 its length.

(5) Fabric is deteriorated or decayed.

(6) Exposed core or metal part is contacting journal.

(7) Missing.

(8) Removed on account of change of wheels and axle.

(9) Journal box repairs require removal of lubricators.

(10) Journal boxes receive periodic lubrication attention (para 4-19).

(11) AAR approval has been withdrawn (para 419).

(12) When involved with a hotbox requiring renewal of journal bearing.

4-18. Periodic Attention-Plain Bearing Journal Boxes

a. Overdated when Equipped with AAR Approved, Conditionally Approved or Approved for Test Lubricators.

(1) *Stenciled with numeral "30" adjacent to repack stenciling information.*

(a) After expiration for 30 months.

(b) After expiration of 29 months when car is on repair track.

(c) Between 24 and 29 months when car has a change of wheels or truck repairs requiring removal of lubricators in one-half of the boxes on car.

(2) *Not stenciled with numeral "30."*

(a) After expiration of 24 months.

(b) After expiration of 13 months when car is on the repair track.

(c) Between 18 and 23 months when car has a change of wheels or truck repairs requiring removal of lubricators in one-half of the boxes on car.

Note. **Cars under authorized test for repack period must be repacked at expiration of such period and all test stenciling removed. However, where conditions In (c) above prevail, they will have priority over test period. Expiration of time limits is defined as after the date of month stenciled on car.**

b. Attention at Any Time.

(1) When stenciled for type of lubricators that are not approved, conditionally approved, or approved for test per AAR Interchange Rules, regardless of type of lubricators in boxes.

(2) When equipped with waste packing.

(3) When stenciling is missing, incorrect, or indistinct.

(4) When not stenciled for any kind (name) of lubricating device.

(5) When boxes have been submerged.

(6) When car is on repair track and all lubricators are defective (para *4-17d).*

c. Correct Repairs.

(1) Remove journal bearings, wedges, and lubricators or waste packing Thoroughly clean boxes, including inside of lid and front of box that could come in contact with lubricator when being applied *Do not use waste for cleaning purposes.*

(2) Examine journal bearings, wedges, journal stops and box lid seals, renew if defective.

(3) Renew dust guard plugs when missing or defective and apply sealer material on top of plug.

(4) Secure wooden dust guard plugs (when used) with a device to lock the plug In place.

(5) Renew defective rear seals only when truck is dismantled for any reason.

(6) Apply new lubricators *only,* in accordance with manufacturer's instructions furnished in each lubricator shipping container. Prior to installation saturate the lubricator in railway car oil If any free oil is visible in bottom of box after lubricator has settled, no further oiling is necessary. If there is no indication of free oil, add oil until approximately 3/8 inch of oil is visible in bottom of box.

(7) Scrape off old stencil and paint over with quick-drying black paint.

(8) Apply stencil (similar to that shown in figure 8-19 for airbrake testing) as follows:

(a) Show place, month, day, and year of repacking.

(b) Show railroad, military, or private line reporting marks.

(c) Show symbol for repack "RPKD."

(d) Use same shop or station initial as used for airbrake stencil (fig. 8-19).

(e) Show name of lubricator applied.

(f) Stencil numeral "30" adjacent to repack stenciling data when car is equipped with sealed and stabilized journal box assemblies.

(g) Stenciling must be on car body, near body bolster at diagonal corners, with not less than 1-inch figures and letters.

Section V. TRUCK SIDE FRAME, BOLSTER, AND SPRINGS

4-19. Truck Side Frame

a. General. The truck side frame is the trussed cast-steel frame of the truck assembly on the outside of the truck wheels, which extends from one axle to the other (fig 4-28). The journal boxes, except for lids, the brake-rig lugs for hanger-type brake beams, and the guide slots for hanger-less-type brake beams are cast integral with the side frame proper. These journal boxes are designed to seat the top bearing wedge and bearing assembly, provide a rear slot for the dust guard and plug, and retain lubricating pads and lubricant for journal and bearings. When the roadbed is not in good condition, especially around curves, the truck side frames will be subject to heavy impact forces. Uneven track and excessive swaying of a car body are the greatest contributing causes to increased wear on side frames. Figure 4-29 shows the disassembled truck with component .parts.

b. Repairs. The truck side frame is subjected to severe stresses and strains under a car, particularly when under load and traveling at high speed. Side frames will wear in the center portion where the springs and truck bolster are located. Cracks also may be found in this area or anywhere on the side frame. Journal boxes may contain broken or worn lugs. A defective side frame

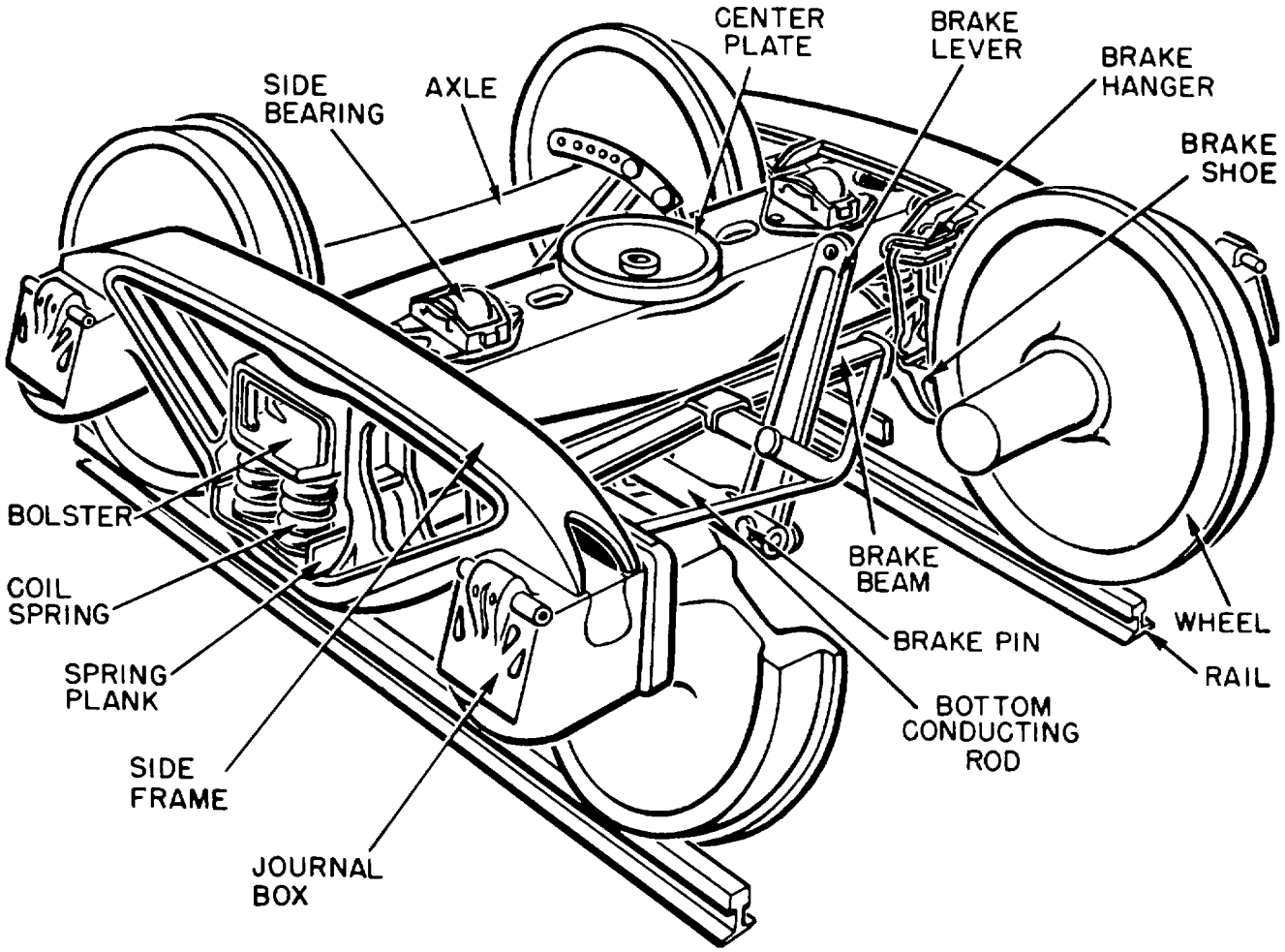
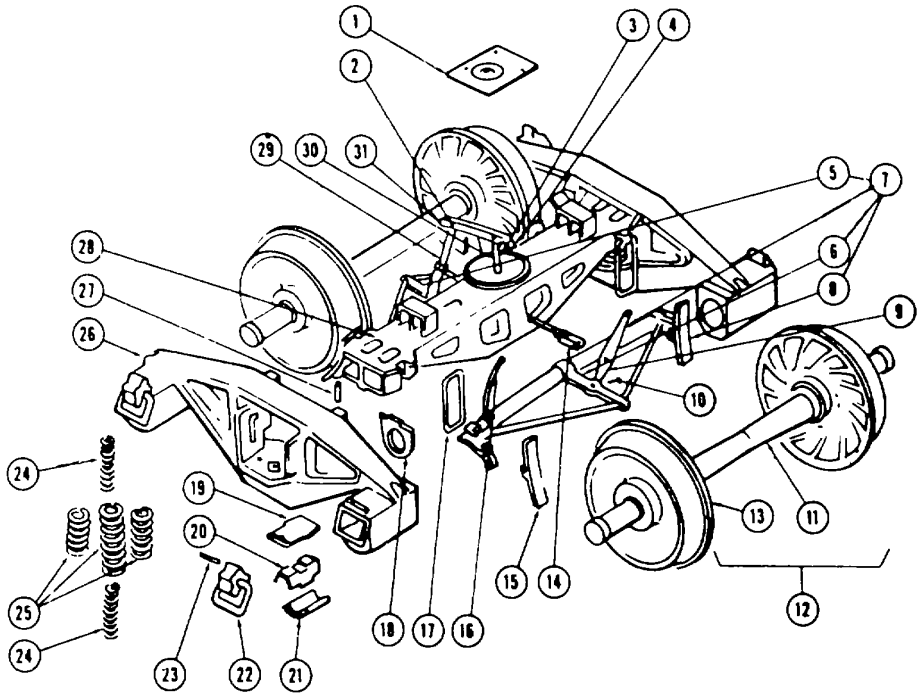


Figure 4-28. Typical truck, assembled.

usually is removed and a new or reconditioned one installed. When it is necessary to build up a !surface by welding, it should be done evenly to produce the desired finish without excessive grinding. Building up of surfaces and the welding of cracks or fractures at any location are permissible on CONUS-type equipment provided the side frame is of U-section design, manufactured subsequent to 1926. In CONUS, AAR Code of Rules governs these repairs Frames must be removed from the truck, and the section to be welded must be preheated locally to approximately 6000 F. before welding is started. Frames must be normalized after welding has been completed and legibly marked with place and date (AAR regulations in CONUS). On certain limited sections of the Journal box and brake hanger bracket, heat treatment is not required.

4-20. Truck Bolster

a. General. The truck bolster (fig 4-28) is the body bearing part of the truck. It is designed to support the car's underframe and load. It is set crosswise and the matching car body bolster rests on it, secured by the weight of the car and the matching of the male and female forged or cast-steel center plates. A loose center pin in the center plates helps resist lateral movement. Under normal conditions, the truck bolster oscillates in its position between the columns of the side frame. On application of the brakes, if severe, the bolster will tilt, and the corners of the bolster will rub against the faces of the truck columns (side frames). With its fitted ends working in and guided by the cast columns of the cast-steel truck side frames, the truck bolster transmits its load to the bottom spring clusters (leaf springs in passenger cars) which have caps and bearing plates. The frame load is in turn transferred to the axle journals and wheels and then to the rails through journal bearing assemblies (brass and wedge) or roller bearings located in the journal boxes of the side frames.



1. Plate
2. Pin, Straight, Headed: dead lever guide
3. Rivet, Solid
4. Bracket, Dead Lever, Truck
5. Fulcrum, Brake Beam: lh
6. Fulcrum, Brake Beam: rh
7. Beam Assembly, Brake
8. Head, Brake
9. Lever, Truck Brake: live
10. Pin, Straight, Headed: brake connection
11. Axle, Railway Car
12. Wheel Set, Railway Car
13. Wheel, Railway Car
14. Rod, Connection, Truck Lever
15. Brake Shoe, Railway Car
16. Key, Railway Car, Brake Shoe
17. Hanger, Brake Beam
18. Dust Guard, Railway Journal
19. Wedge, Railway Journal Bearing
20. Bearing, Plain, Railway Axle
21. Lubricating Pad, Journal Box
22. Lid, Railway Journal Box
23. Pin: journal box lid
24. Spring, Railway Truck: inner
25. Spring, Railway Truck: outer
26. Side Frame, Railway Truck
27. Bracket Cotter, Brake Hanger
28. Bolster, Railway Truck
29. Lever, Truck Brake: dead
30. Pin, Center, Railway Truck
31. Guide, Truck Dead Lever

Figure 4-29. Typical truck, disassembled.

b. Bolster Repairs

(1) Bolsters wear at the center plate, at the side bearings, and at the ends where contact is made with the columns of the side frames as discussed in a, above. It is generally feasible to build up worn spots on cast-steel bolsters by welding if AAR (CONUS) and TRS (overseas) regulations permit. A bolster worn beyond reclaimable limits must be removed, scrapped, and a new one installed. There are no restrictions on welding of pressed or structural steel bolsters.

(2) To remove a truck bolster of the integral cast frame type illustrated in figure 4-28, the following procedures will apply:

(a) Remove all packing (or lubricants) from journal boxes.

(b) Disconnect top brake rod from truck live lever.

(c) Jack end of car to a height sufficient to allow truck to be rolled from under the car.

(d) Place safety trestles under corners of car so that if the jacks fail, the car will not fall.

(e) Remove center pin. If it is necessary to roll truck from under car before placing safety trestles, a pair of long-handled *tongs-never bare hands-will* be used to remove the center pin.

(f) Roll truck from under the car.

(g) Remove all brake rigging, including brake beams, rods, levers, and safety hangers.

(h) By means of jacks or hoists, raise bolster sufficiently to permit removal to journal box wedges.

(i) Remove spring plank if used.

(j) Lower bolster to a position, which will allow the side frames to be slipped from ends of bolster

(k) Using hoists or wheel sticks, swing side frames clear of bolster.

(l) Remove bolster.

(3) To reassemble the truck, lower the bolster into place, roll up the wheel sets, put the side frames into position, and assemble the remainder of the parts in the reverse order of the disassembly, described above. Bolster side control wedges (if used) should be lubricated after assembly.

c. Welding Bolsters. Inspection of bolsters removed from car trucks may reveal loose rivets in the male and female center castings and cracks 'in the body of the bolster. There are no restrictions on the welding of cracks or fractures in bolsters, but cast-steel bolsters must be removed from the car before welding and normalized after welding. Pressed or structural steel bolsters should be removed from the car truck if major cracks or fractures are detected. Loose rivets in the center plate will be cut out and replaced.

d. Center Plate The truck bolster center plate (fig. 4-28) is a depression into which the center casting riveted to the center sill of the car fits. It is held in place by the weight of the car body, the conformation of the casting, and a center pin. The center plate should be inspected for the presence of dirt, grit, scale, or any foreign matter which will cause binding and above average wear. The center plate and pin should be lubricated with suitable hard grease prior to being replaced under the car. The center plate should be examined for cracks and broken portions. If damage is noted, the center plate and bolster, if necessary, should be removed as outlined in b, above, and replaced with a new one. If the center plate is riveted on, it can be replaced singly. Liners or shims placed in center plates to adjust coupler height (para 4-2) are permissible, providing the vertical bearing surface of the center plate is not reduced below 1 1/8 inches. Such liners shall be of one piece not to exceed 1/4 inch thickness. To inspect center plates for cleaning and lubrication, the car can be raised by hoists or jacks to a sufficient height to make the center plate visible for inspection. Care should be taken not to put the hands or fingers into the center casting under such circumstances.

e. Side Bearings. Side bearings, consisting of special steel plates with flat bearing surfaces which contact similar plates on the body bolster, are fabricated as a part of the bolsters. They are designed to steady the car body and prevent excessive rocking by maintaining intermittent contact with similar members of the body bolster. Instead of a flat bearing surface, a combination of rollers and rockers may be found on some cars. New cars specifications require side-bearing clearances to be adjusted within the limits of 1/8 inch to 1/4 inch per bearing, measured at each bearing, with the car on level track and the car body level. Total side-bearing clearance at B-end and R and A-end L and A-end and R corners must be the same as the total clearance at B-end L and A-end R corners, with a permissible variation of 1/8 inch. By raising the end of the car above the trucks, the side bearings can be inspected for wear or breakage. If repairs or replacement are indicated, the truck should be rolled out from under the car to facilitate the repair. If replacement is necessary, the old side bearing can be burned off and a new one affixed by riveting or welding in its original manner. Care will be taken to adjust for proper clearances.

4-21. Truck Springs

a. General. The truck bolster ends, properly fitted between the columns of the truck side frame, will rest - on unit clusters of coil springs (fig. 4-28) which, in turn, are set into built-up shouldered spring pockets of the truck side frame and truck bolster. The makeup of the spring clusters is dependent upon the loads and spring travel dictated by operating conditions.

These clusters, with cap and seat plates, are removable, since they are fixed to neither the bolster nor the side frame.

b. Spring Replacement. Bolster coil springs (fig 4-28) may break and become lost. When this occurs to one spring, it is not too serious. However, additional strain is thereby placed on remaining springs and In case of a heavily loaded car they may be unable to carry the load, thus possibly resulting in truck failure, hot journal, derailment, or other serious damage. Rusting or breakage of connecting parts may cause a spring to become loose and eventually lost. If the spring plank is damaged, great pressure will be applied to the springs, resulting in broken springs or the tilting of the truck. When a spring is found broken or missing, a new spring will be installed. To do this, the truck can be partially disassembled following the procedure outlined above. The weight must be taken from the bolster and bolster 'raised high enough for the spring to come free. New springs should fit the spring seats exactly and have the same snubbing characteristics as the other springs in the group.

CHAPTER 5

UNDERFRAME ASSEMBLY

Section I. GENERAL

5-1. Underframe Sills

a. Center Sill. The center sill of a structural frame is the built-up central, longitudinal structural member of the underframe of a car and forms the backbone of the underframe. It transmits the buffing shocks from one end to the other. It contains the couplers and draft gears in pockets at either end.

b. Side Sill. The underframe side sill is the outside longitudinal member of the underframe. In some cars, especially flatcars, the side sills are strengthened. In other cars, such as gondolas and copper cars for example, the entire side of the car may be designed as a deep plate girder or truss to carry much of the load to the bolster. On hook-and-link equipped cars, it is reinforced to withstand buffer shocks.

c. End Sill. The end sill of an underframe is the tranverse member extending across the ends of the longitudinal center and side sills. This member may be fabricated of rolled or pressed steel, with sill connections of either a bracket or gusset-plate type.

d. Floor Stringer. In steel car construction, the term floor stringer is applied to the longitudinal members sometimes used to support floors. Longitudinal floor stringers sometimes occupy positions similar to intermediate sills, but are not designed to act as sills.

5-2. Underframe Body Bolster

The body bolster is the transverse member of the underframe over the car trucks through which the weight of the underframe, super-structure (if any), and the lading of the car carried by the longitudinal sills is transmitted to the truck. The body bolster carries and transmits its load through the mated body bolster and truck bolster center plates, the body bolster resting on the truck bolster. A typical welded-steel underframe is shown in figure 5-1

5-3. Crossbearers and Crossties

Crossbearers are transverse structural members of the underframe placed between the bolsters. They act as a tie between the body side sills and the center sill anchorage and help to distribute the weight of the car and lading and to stiffen the structure. Crossbearers built as single units extend across the car from side sill to side sill, usually with a filler between the center sills. The term crosstie is commonly applied only to those members which tie together the side sill with the near-side members of the center sill.

5-4. Striking Plates or Castings

The striking plates or castings are a component part of the coupler and draft gear arrangement. They are riveted or welded to the end sills and fitted around the opening for freight car couplers. They help prevent damage to the center sill, as the coupler horn will strike when the draft gear is weak or defective.

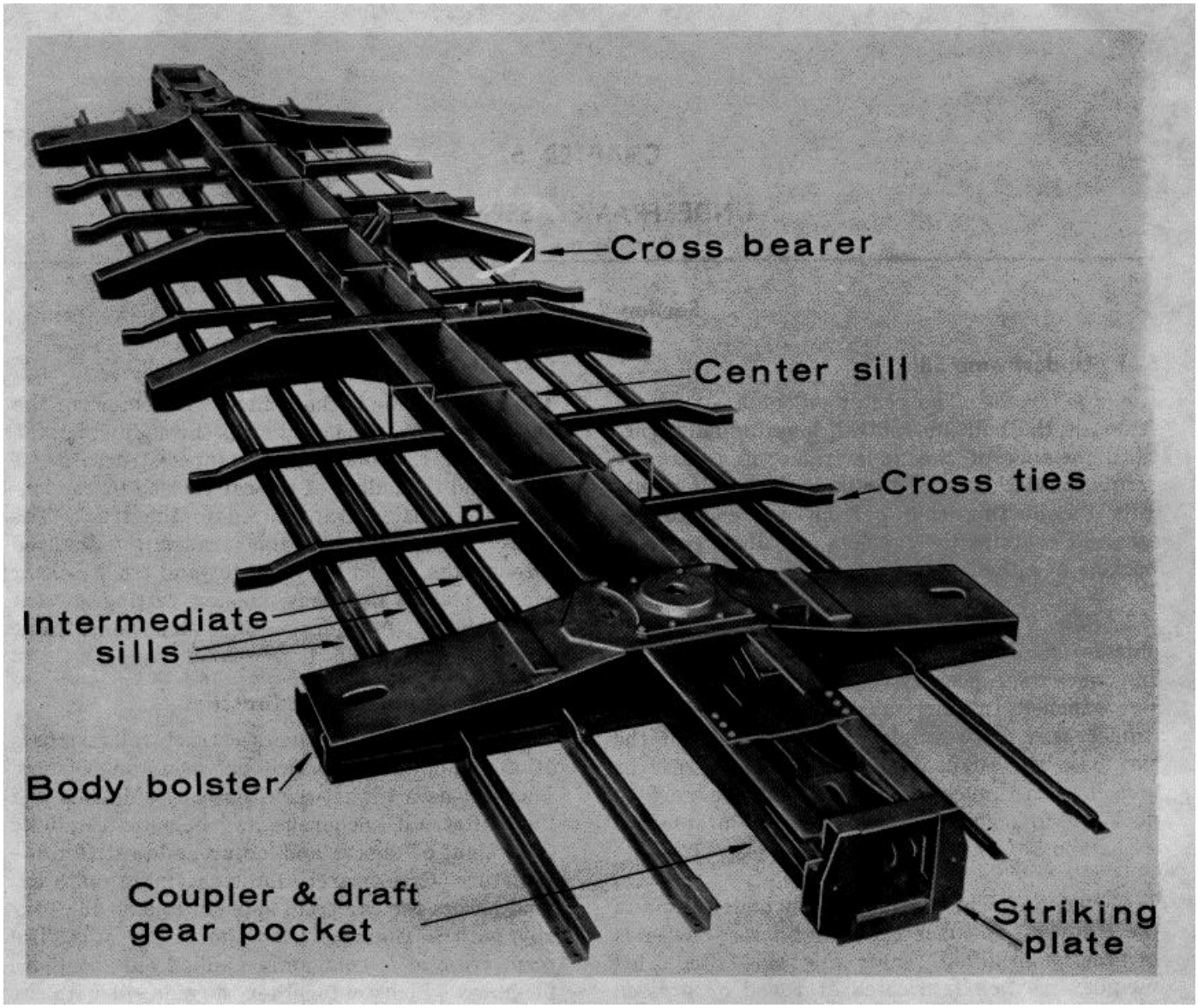


Figure 5-1. Typical welded-steel underframe.

Section II. UNDERFRAMES FOR CARS USED IN THEATERS OF OPERATION

5-5. General

One of the basic developmental requirements of the oversea fleet was a flatcar underframe upon which satisfactory superstructures for boxcars, high-side and low-side gondolas, and possibly caboose cars could be easily and economically assembled in the field and then used in service with a minimum of maintenance. The 40-ton oversea flatcar with its underframe truss-rod features is built to take the standard automatic coupler at a 34 1/2-inch coupler height as well as the European hook-and-link coupler or the Willison coupler at a 41-inch coupler height. The change in ,coupler height is accomplished by the use of collars between bolster center plates and shims at the side bearings of both the body and truck bolsters. Design load limits are fixed at 34,000 pounds per axle based on use of 5- by 9-inch axles.

5-6. Field Assembly and Maintenance

Underframes of the knocked-down oversea fleet are completely fabricated at the car builder's shops in CONUS. They are shipped to depots for storage and/or transshipment overseas. Field assembly of flatcars will involve placing the underframe on truck assemblies, inserting the klngplns and keys, and mounting the brake cylinders and foundation brake gear, including the necessary connection with that part of the foundation brake gear built into the truck assemblies. Oversea underframe maintenance will probably consist almost entirely of structural repairs, which are discussed in the following section. Figures 52 and 5-3 illustrate two steps in the assembly of knocked-down type cars.

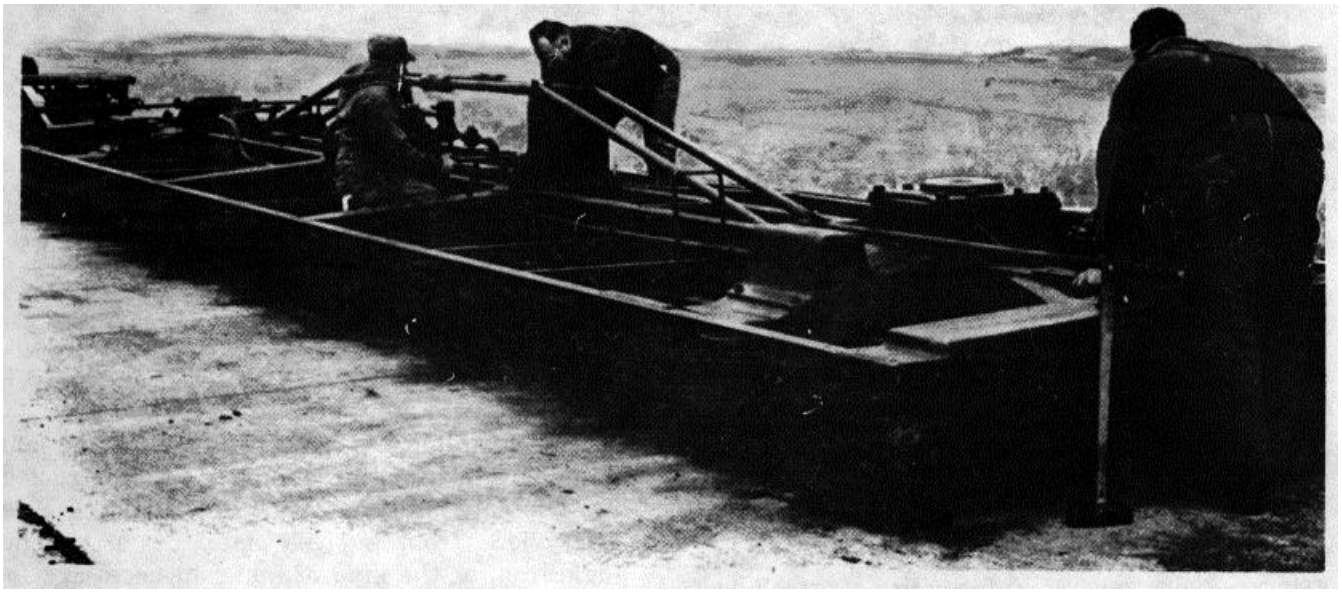


Figure 5-2. Component parts being installed on underframe.

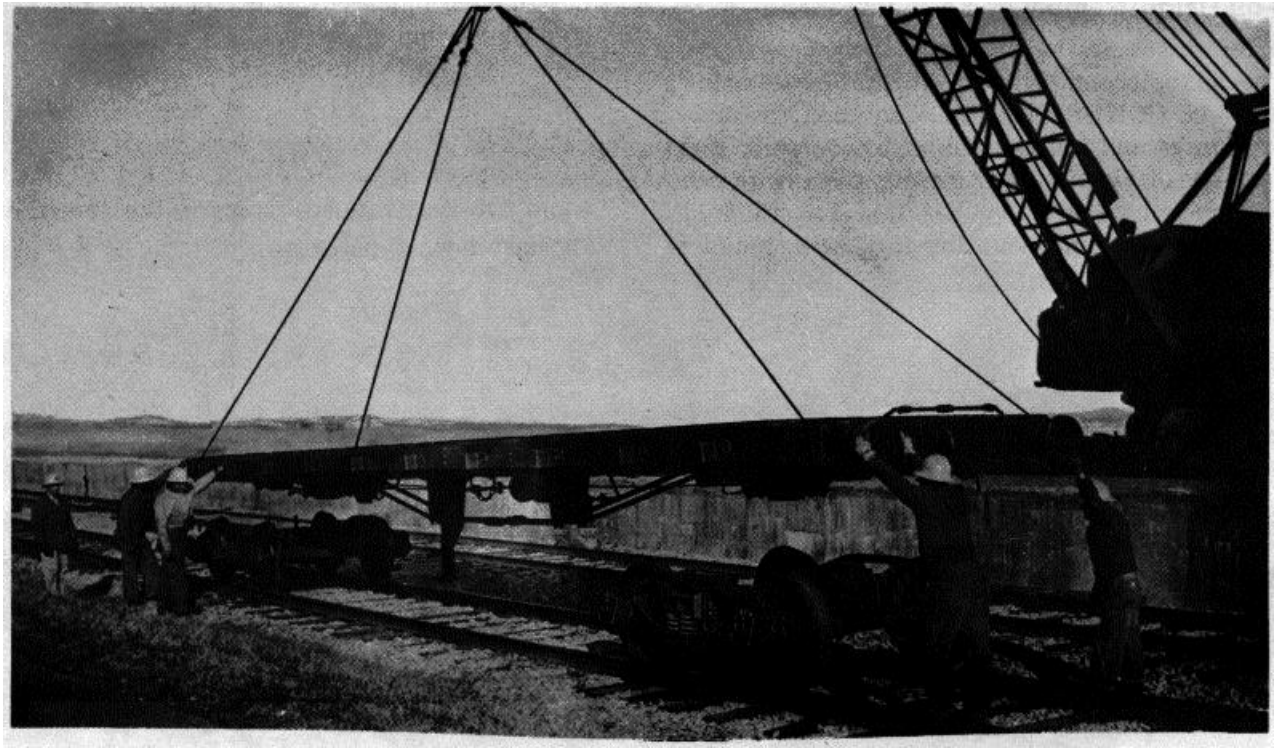


Figure 5-3. Lowering completed underframe on trucks.

Section III. REPAIR PROCEDURES

5-7. General

The usual procedures to be used in making typical repairs to car underframes and/or their components are discussed In the following paragraphs; only general information is included. The nature and extent of the damage, the accessibility of the damaged parts, preliminary disassembly or removal of components, and other factors determine the individual steps required for any particular repair job. Details are not discussed, but the general procedures to be followed in repairing certain damaged parts or frame members are Indicated. Exact methods are based on the good judgment and experience of the carman.

5-8. Special Jobs

a. Use of Templates. Special kinds of repairs may require a special pattern of patch. After the method of repair has been determined, a template of the patch should be made. When a part is to be replaced by a new one, a template insures that the new part will fit exactly and that any necessary holes or cuts will be marked out correctly with a minimum of lifting and figuring. Templates of skeleton construction, braced to retain shape, are the easiest to make and to handle. A template should be of light construction for ease of handling. After careful measuring and planning, the required template is constructed. The template is used to mark for cutting the desired piece from a steel plate, beam, channel angle iron, or the kind of material necessary for the repair. The template is also used for marking the new piece The piece is placed on firm, heavy planks supported with benches, horses, or some heavy base, as illustrated in figure 5-4. The template is clamped In position on the piece, and holes and cuts are marked. After the template is secured, the piece is ready for cutting and drilling, followed by installation on the underframe or other part of the car Figures 5-5 and 5-6 show templates for angles and I-beam, respectively. When it is necessary to make several duplicate parts, stops on the templates (fig 5-5) save time and trouble.

b. Straightening Out-of-Square Underframes. When a car is sideswiped or receives a blow on a corner, the whole underframe may be forced out of square. The end and side sills may be bent so badly that they must be removed. They are later heated and straightened under the press. The -center sill, body bolsters, crossties, diagonal braces and the remainder of the underframe can be left connected. Two chains are attached, one around the end of each body bolster, and brought

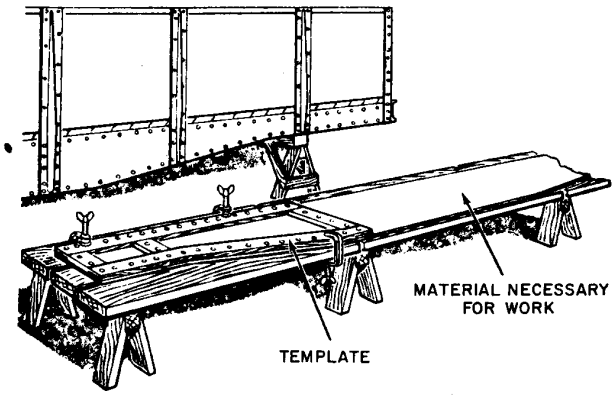


Figure 5-4. Marking with templates.

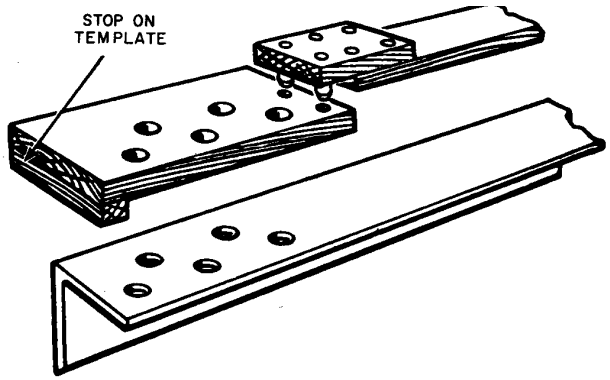


Figure 5-5. Template for angle.

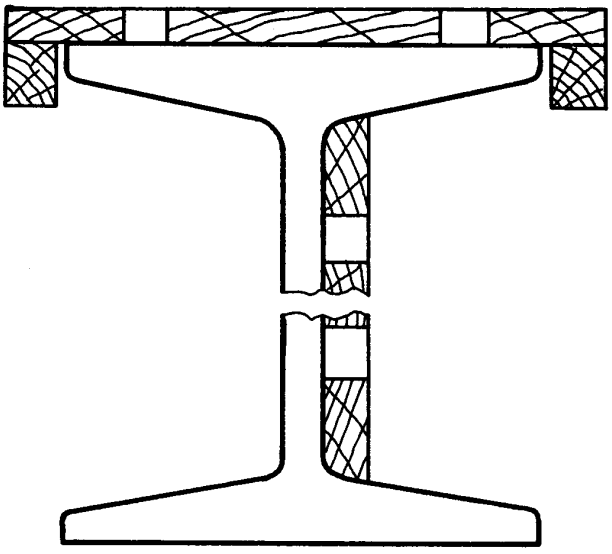


Figure 5-6. Templates for I-beam

together In the middle of the frame with a pull jack. The pull jack exerts a diagonal pull on the underframe, bringing it back into square. Application of heat 'to the center sill may speed the operation.

5-9. Steel Splices

a. General. Frequently, underframe sills are cracked or broken through deterioration, rough handling, or accident. In many cases the crack or break is of such proportion or in such a location that the whole member must be replaced. In other cases the sill may be repaired by "splicing." Where practicable and especially in a theater of operations, splicing of sills is recommended. Splicing may be done on a sill adjacent to another splice or adjacent to a sill that is spliced Whether the break is on the inside, outside, or completely through, the procedures will be generally as explained in b, below. In all cases of splicing, reinforcing cover plates must be used on each side of the broken sill, over the fracture.

b. Center Sills. Before a broken sill is spliced, measure the web and flanges A piece of steel plate as thick as the sill to be spliced will be used in marking off and cutting out the splice The location of rivet holes are then marked off on the sill to be spliced Marking off may be done by using a template as described in paragraph 5-8a or by measuring and marking. After the splice plate is put in place, the holes to be made are (marked for punching or1 drilling Before any holes are made in the sill, the adjacent broken parts of the sill must be drawn together by bolts for butt-joint splicing These tie bolts hold the sill until the splice is secured. In CONUS, AAR regulations may require welding of the break before application of the splice cover plates As soon as the sill is prepared, the cover plates are applied and riveted. The riveting process is discussed in paragraph 5-19.

c. End and Side Sills. Because of the stresses land strains to which the end sills are subjected, they are frequently badly bent between the buffer and the corner of the car. This damage may be repaired by placing a jack against the bent part any applying heat to the sill with an acetylene torch, at the same time tightening on the jack as illustrated in figure 5-7. This usually will restore an end sill to its original position. Side sills usually can be straightened in a similar manner.

Small kinks in side and end sills may be straightened by heating and hammering Broken side sills may be spliced at any point between the end sills.

d. Crossbearers Defective Crossbearers usually are cut out and replaced with new ones, since they connect to the center and side sills. While it is a simple operation to remove them, crossbearers may be patched if it can be done satisfactorily. Whether replaced or repaired, the crossbearer must be removed by cutting the rivets

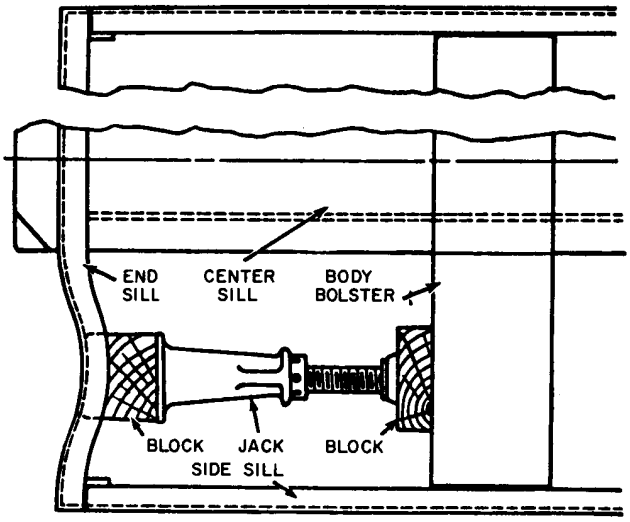


Figure 5-7 Straightening a pushed-in end sill by jacking against the body bolster.

which connect each crossbearer to the center sill and side sills (fig 5-1). If the angle irons, which connect the two arms, are good they can be cut loose and used on the new crossbearer. In theaters of operations where acetylene is not available, rivets can be removed manually by cutting the heads off with a chisel bar and sledge hammer, and knocking the old rivet body out by use of a drift punch and hammer.

e. Stringer Supports. Defective stringer supports usually are replaced They are removed in a manner similar to that described for renewing crossbearers.

5-10. Draft Castings

Draft castings are frequently found broken or missing. Broken draft castings can be removed by taking out the draft gear, the coupler, and uncoupling level. The rivets which hold the draft casting in place can be removed by using acetylene torch equipped with a rivet-piercing tip. If a rivet buster is available, the punch can be substituted for the chisel and the old rivets backed out. When the rivets are removed, the draft casting can be easily lowered out. The new draft casting can then be riveted (or welded) in place.

5-11. Cover Plates

The center sill cover plate may be patched by cutting out defective parts and replacing them with new ones. The new plate should be of the same thickness as the old cover plate and should be lapped about 6 inches at the point of the old cover plate. Defective body bolster cover plates should be removed, since they bear too, much strain to make a patch practical.

5-12. Body Bolster Fillers

a. General. Body bolster fillers are frequently broken. Substantial repairs can be made with a patch flanged on top and bottom to fit the place to be patched or spliced. Such patches should extend at least 12 inches on each side of the break. They should be secured by rivets through the web on each side, staggered to fit the condition. In CONUS, where AAR rules permit, the patches can be welded When riveted, rivets securing the top and bottom flanges of the patch to the flanges of the bolster should be long enough to go through the top and bottom cover plates. Usually, however, it is best to cut out broken body bolster fillers and replace them. To remove a pressed-steel flanged filler, the top and bottom cover plate must be cut loose and the rivets which connect the filler with the center sill and side sills must be cut The rivets which connect the adjacent crossbearer to the side sill must also be cut The side sill can then be sprung out far enough to allow the old filler to be removed and the new one fitted into place.

b. Body Bolster Center Plate. Broken body bolster center plates must be renewed. The rivet heads are cut off with an acetylene torch or a rivet buster and the old rivets punched out. Sometimes the center plate will have to be pried down after the rivet heads are removed because the plate shanks are bent sideways to fit the small space between the lower bolster cover plate and the center plate In this case, the rivet shank cannot be driven up and it will be necessary to burn off the rivet shank below the center plate before the upper rivet head can be removed. During riveting (or welding), the new plate can be held temporarily in place by two diagonally placed bolts.

5-13. Straightening and Repairing Sills

a. General. If a center or side sill is so badly broken or damaged that repair is impractical, the sill must be cut out completely, removed and replaced with a new one. It must be disconnected from the end sills, the body bolsters, the diagonal braces, the crossbearers, and the stringer supports. When the new sill is installed, it must be connected to all these same parts.

b. Broken End Sills. When an end sill breaks, the break usually occurs in the center. In this case, it is better to cut the end sill off and replace it with a new one. The new end sill should be of heavier design that the original damaged

one. To remove the end sill, it is necessary to take the grab irons and uncoupling lever casting off If the sill has a cover plate, the cover plate should be removed. After the sill is stripped, the coupler should be removed, and the striking casting, corner braces, and diagonal braces removed The old grab irons and uncoupling lever castings, if undamaged, may be replaced on the new sill. The new end sill is then put in place and riveted or welded to all connecting parts. Broken end sills can be repaired, if necessary. The striking casting is removed and a patch flanged to cover the top leg of the sill, extending down the face of the sill and riveted (or welded) both to the face and to the top leg. This patch must be at least 24 inches long and of heavy material.

c. Bent Sills

(1) If a sill is badly bent, it must be removed for repair Such sills should be heated in a furnace and straightened under a press. Sills bent out of line to one side or the other can be straightened by placing the underframe In a jacking stall where it may be jacked back. Whether a jacking is used or not, the procedure is the same. Jacks should be placed against the point farthest out of line. Anchor jacks can be placed at the most convenient points along the sills, depending upon the extent of the bend. Jacking both ways will restore the sill to its former position When jacking such sills into 'line, it is always best to jack them slightly past the point of alinement. This permits them to spring back to some extent toward their original set when the jacks are released.

(2) Center or side sills which are bent down at either end usually can be straightened by chaining the underframe firmly to the rails at the body bolster and jacking under the end of the affected sill. If the sill is bent up at the ends, it may be firmly secured from the underside at the ends and the frame can be jacked up at the center. If the sill is bent down in center, both ends may be secured firmly at the body bolsters and jacks may be placed under the center. Jacking up will restore the underframe to its former position.

5-14. Diagonal Braces

These braces extend from the body bolster and the top flanges of the center sill to the top flanges of the end sills and side sills. These braces may break, or the gusset plates which fasten the braces at each end may break In either case, the diagonal braces and the gusset slates usually are cut out and replaced. The rivets at the points of connection must be cut to release the braces

5-15. Striking Castings

When these castings are broken or badly damaged they should be cut loose and replaced.
Rivets are burned or cut off, then punched out, the old striking casting removed, and a new one riveted into place.

Section IV. RIVETING

5-16. General

In car repair work, rivets are universally used for holding plates together or joining plates to structural shapes or members. In most instances where splicing is done, cover plates are required. These cover plates are secured by rivets to the structure or member repaired. Rivets generally are heated in portable compressed air operated forges; however, one or two rivets for a small job can be satisfactorily heated by an acetylene torch Standard practices and safety precautions should be observed while riveting (DA Pam 551). The rivets used in all riveted splicing should be the same as the existing types in the underframe.

5-17. Types of Rivets

a. General. Rivets used in freight car work have four different types of heads, depending on the place where they are to be used: button, cone, countersunk, and steeple. The button head is the most common type, because it is most easily formed. In repairing tank car interiors, cone head rivets are used because they are strong and do not chip easily. Steeple head rivets are used in the floors of hopper cars because they have the least tendency to retard the bulk loading when the car is being dumped. The countersunk head is used where a finished flat surface is required, such as a place where the part riveted and the rivet heads are to be covered by a plate, or where clearance is required between moving riveted parts.

b. Rivet Length. The proper rivet length is determined by the thickness of the parts to be joined. The rivet must be long enough to project beyond the rivet hole and leave sufficient shank so that a head can be formed at the end. The length of shank necessary to form a head varies

from 1 inch for a 1/2-inch-diameter rivet to 1 1/2 inches for a 7/8-inch rivet. Generally, a shank must be twice the diameter of the rivet. If the proper length of the rivet is not available do not attempt to use a rivet of shorter length, because a flat, insufficient head will be formed, the shank may fail to fill the hole, and the rivet will become loose. If the proper length rivet is not available, select one that is longer than required and cut it to the proper length. Do not use a rivet that is too long without first cutting it to length

5-18. Rivet Fitting

a. General Before any riveting is done, the parts to be joined must be secured in correct relative positions. This is done by inserting special fitting-up bolts into enough rivet holes to secure the parts and the parts drawn lightly together. These bolts should be exactly the same size as the rivets to be used and will be removed only when rivets have been driven in the remaining holes. Where the surfaces do not come tightly together, striking them with a sledge and simultaneously tightening up the bolts will help to pull them close. Fitting up bolts should be so located that the majority of the punched holes are in alinement. If not so alined, holes may be reamed.

b. Rivet Spacing. The spacing of rivets is determined by the particular job, type, and thickness of plate and/or casting, etc. Generally, the distance between rivets, center to center, should not be less than three times the diameter of the rivets; the maximum center-to-center distance should not exceed 6 inches for rivets of 3/4-inchdiameter shank or larger; and center of rivet (holes should not be less than 1 1/4 inches (for 3/4and 7/8-inch rivets) from the edge of the ,piece being worked, except where the piece is less than 2 1/2 inches wide. When it is, the distance from the edge of the piece to the center of the .rivet hole should be at least twice the diameter of the rivet but should not exceed eight times the thickness of the plate. When the plate being worked is adjacent to legs of angles or flanges, there should be an allowance between the legs and the rivet centers of at least 3/8 inch plus 1/2 the diameter of the rivet head.

5-19. Rivet Driving

a. General. Riveting should begin at one end of the piece or plate and continue around the fitting bolts which are holding the members together. Rivet along the piece and do not skip from place to place, as skipping fails to draw the parts together tightly. Hot rivets contract in cooling and draw the pieces more firmly together. Therefore, rivet driving should be done systematically and new rivets driven, alongside cooling rivets. Surfaces next to riveted pieces of metal should be coated with a rust preventive paint to minimize rusting out of parts.

b. Driving Methods. Rivets should be fitted squarely into the hole so that the hole is completely plugged. The point of the rivet should not be bent over but should be upset so that it fills the hole its entire length. The riveting hammer used should be powerful enough to form a perfect head without rocking the hammer to work down the edges. The hammer should be started slowly and applied lightly until the rivet has settled into the hole and enough head has been formed to hold the rivet in the hole, then full pressure can be applied. To obtain tight rivet work, it is essential that the rivet be handled and seated in the hole while red hot and completely driven before cooling. The method used to form the rivet head depends upon the type of riveting machine used, but will fall into one of the following categories: compression; succession of rapid blows; rapid blows accompanied by rotary motion of the rivet set; combined compressive and rolling or spinning motion; and application of pressure to an electrically heated rivet. To drive flat-head countersunk rivets, the hammer must be held firmly in position so that it does not slip off the rivet. One way to do this is to hold the 'hammer

c. Riveting Machines. There are two general types of riveting machines, the air (pneumatic)driven riveting hammer and the yoke or gap riveter. Pneumatic hammers are most commonly used. The short-stroke hammers are suitable for driving rivets of 5/8-inch diameter or less, the long-stroke hammers for driving all larger sizes. Other forms of riveting machines include the portable yoke riveter; the pinch bug portable riveter; a portable hammer-type yoke riveter; and stationary riveting machines, such as yoke riveters, bull riveters, and hydraulic riveters.

d. Riveting in Enlarged Holes. Standard steel working procedure requires reaming holes in surfaces to be joined so that the holes are in perfect ,alinement. It is not always possible to do this in freight car repair work. The hole in the old part may be enlarged from wear, and any reaming may weaken the part. In such cases, use a rivet which fits the smaller hole. By slanting the hammer

first in one direction to fill the larger hole and then slanting it in the opposite direction, the rivet can be driven so as to fill the entire hole. The hammer can then be rotated to round off the rivet head and clinch its edge to the repaired surface.

e. Riveting in Partly Inaccessible Locations. In many instances, because of projecting parts, it is difficult or impossible to obtain clear access to, a rivet. In such cases the hammer may be slanted from various sides so as to swell the rivet shank and hold the rivet more securely in place.

f. The head should be almost completed. Then the edges can be clinched and the head rounded off. In some instances, specially devised apparatus may be used to reach the most difficult and inaccessible spots. An example is the Installation of draft castings on, the center sill for use with draft gears. Pipe, provided with a rivet header, can be bent to the desired shape. The bent portion will be placed against a fixed structure so that pressure exerted against the opposite end will force the rivet header against the rivet. The other end of the rivet shank can then be formed into a head.

CHAPTER 6

DRAFT GEAR

6-1. General

As noted in paragraph 3-6, the draft gears in a car are mechanisms which connect the couplers to the underframe. Their purpose is to absorb the shocks of coupling and train movement. Various kinds of draft gears have been developed, but Army-owned rolling stock generally is equipped with the friction type illustrated in figure 6-1. Draft gears used in Army-owned or DFRIF (Defense Freight Railway Interchange Fleet) cars (in CONUS) are usually Cardwell, Miner, National, or Westinghouse spring and/or friction types. However, some of the newer DFRIF cars may be equipped with the shock-resistant rubber cushioned draft gears made by one of the various commercial manufacturers. These draft gears are discussed in paragraph 6-3. Yokes, followers, arms, and other attachments make up a complete draft gear installation Some cars, particularly oversea types, may be equipped with either spring or friction-type buffers to provide more cushioning against shock The travel must be not less than 2 1/2 inches, nor more than 2 3/4 inches, and the draft gear followers must be at least 2 1/4 inches thick. In most draft gears, the friction surfaces are the only elements subject to wear. A disassembled draft gear and yoke are shown in figure 6-2.

6-2. Friction Type

a. General Any draft gear must create as low an initial resistance to the compression of the draft gear springs as possible to permit the slack to be taken up and the train to be started smoothly, one car at a time. From this point on, an increasingly high resistance must be created to prevent the closure from coming too soon. Also, when the coupler pull is decreased, a rapid and powerful recoil must not accompany the release of the gear. Low initial resistance, followed by an increasing resistance, is attained by arranging each spring so that one of the ends butts against the friction member of the gear. When springs begin to compress, pressures of the friction elements will be relatively low and the resistance to compression of the springs will be at its lowest. As compression steadily increases, thrust on the friction devices increases. As a result, resistance to the complete closing of the springs increases progressively as the pull on the coupler increases. Upon release of the gear, the friction elements cause the springs to expand gradually, thus preventing strong recoil. Regulations include test requirements for friction-type gears, covering minimum exterior dimensions, restrictions of the travel of gear, and limits on the minimum closed length of the gear under specific load conditions.

b. Components. All approved friction draft gears consist of two major components-a coilspring unit and a friction unit assembled within a single housing. The coil-spring unit usually is composed of a nest of coil springs fitted within the housing, with frictional elliptical springs or friction segments of steel blocks or plates seated in a grooved wedge Whatever form the friction unit may have, the action will be similar. As the coil springs begin to compress, they meet the resistance of the fixed friction unit. As the force on the springs increases, they compress further and the friction unit offers further resistance. This combined action of the units contributes to the smooth starting of the car. The recoil of the springs is diminished when the pull is relieved and any slight vibration that may follow a recoil is prevented from being transmitted to the car. The performance of the friction and coil-spring units is similar when the gear is suddenly pushed rather than pulled. Briefly, the friction-type draft gear, by eliminating spring recoil, insures smoother starting of a car. When the force of the coupling, whether it be by pull or buff, is removed, there is no violent action of recoil as there would be from a simple coil-spring draft gear

6-3. Cushioned Rubber-Type Gear

A multipad, twin-cushioned, two-way rubber draft gear has been developed and accepted as standard for use on both freight and passenger

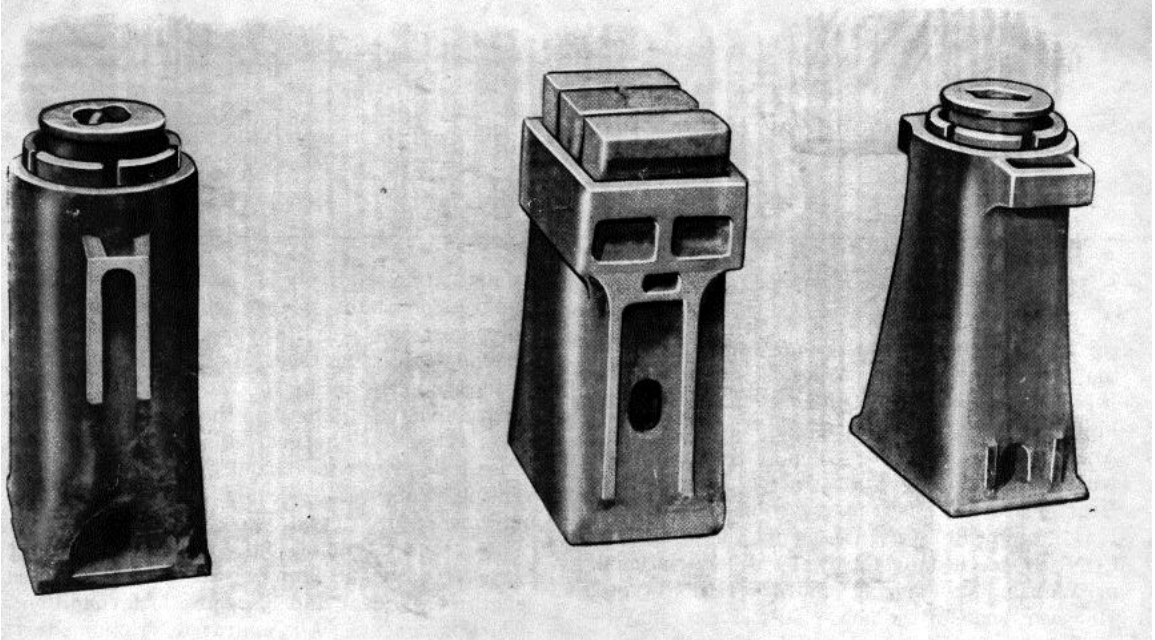


Figure 6-1. Typical friction draft gear.

cars. These twin-cushioned gears are designed to fit the standard freight-and passenger-car draft gear pocket. None of those draft gears are currently used in Army-owned rolling stock but may be found in newer DFRIF cars especially designed to reduce shock in the movement of sensitive materials.

64. Replacement Procedures

a. General. Defective parts of draft gear attachments must be renewed when detected. Splicing and patching is unauthorized except as an emergency measure, because the failure of draft gear attachments can result in considerable damage to the car and its lading. Except for center sills and draft castings, parts of the draft gear must be normalized after any repairs by welding.

b. Disassembly.

(1) To disassemble a draft gear arrangement, the coupler must be removed from the yoke using the procedure described in paragraph 7-5f(1) through (8). The yoke draft gear assembly may then be dropped in one of several ways:

(a) Chock the car wheels at the opposite end to the end being worked. Remove the uncoupling lever, draft key, coupler, etc.

(b) Disconnect the brake rod to the truck /at the top of the live lever. Jack up the end of the car, and roll the truck out of the way.

(c) Place suitable jack or hydraulic lift under the yoke.

(d) By use of hydroram or steel wedge, compress the draft gear free of the follower and block it.

(e) Remove the carrier iron bolts.

(f) Lower the draft gear and yoke assembly from the pocket.

(2) Where the type of car, draft gear, and facilities permit, it may not be necessary to remove the truck from the car. In many cases the draft gear may be removed by following steps (a), (c), (d), (e), and (f), above, only.

(3) When hydraulic jacks or lifts are not available, a truck jack may be used as a field expedient, as follows:

(a) Remove the uncoupling lever, etc. ((1) (a), above), but leave the draft key in place.

(b) Compress the follower away from the lugs ((1) (d), above).

(c) Place 2" x 10" oak or other heavy board under the draft gear with one end resting on the axle of the nearest wheels, one end on the ground.

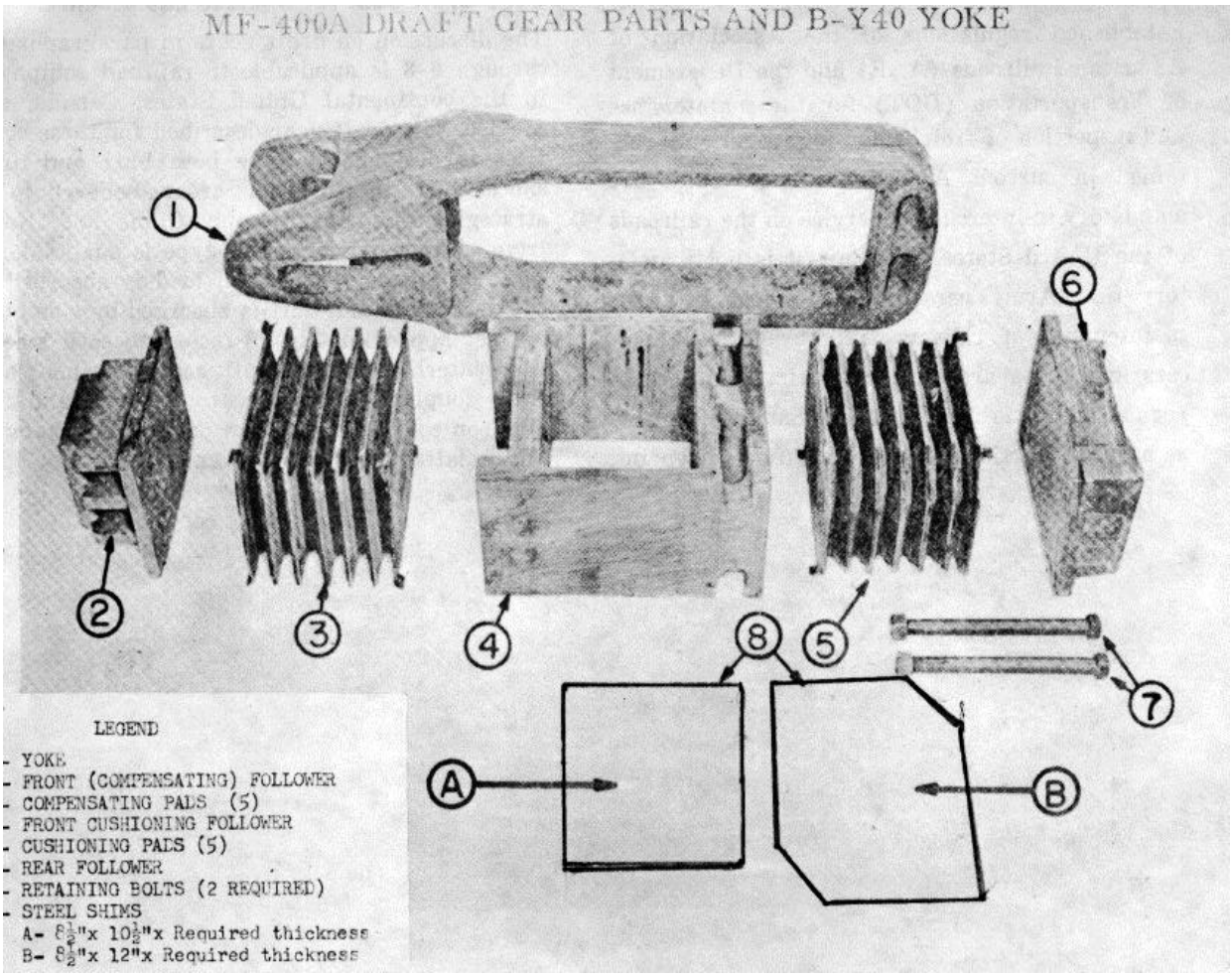


Figure 6-2. Draft gear parts and yoke.

(*d)* Raise the outside end of the board to maximum possible height and place suitable size track Jack (or other Jack with a projecting foot) under the end of the board.

(e) Place a suitable size wooden block on the board directly under the yoke, jack up the board to take the weight of the draft gear and yoke.

(*f)* Remove the draft key, slide the coupler from its pocket, remove carrier iron bolts, if any.

(g) Lower draft gear and yoke assembly to ground.

Note. As as draft gear and attachment may weigh over 600 pounds, a low-wheeled service truck with a hydraulic or pneumatic Jack should be used if available.

c. Reinstallation . Reinstallation of the draft gear is largely a reversal of the procedures used in removal To reinstall the draft gear, followers, and yoke, compress the gear approximately 1/2 inch by driving a steel wedge between the follower and the yoke. This permits these parts to be lifted and properly placed in the draft gear pocket without difficulty. The wedge must be removed after the gear is hooked up. If the space is such that the wedge cannot be conveniently taken out after the gear is in place, a small piece of hardwood should be inserted in place of the wedge after the draft gear is compressed. All swivel pins, draft keys, carrier irons, and retainers must be protected against loss by bolts or cotter keys. After the gear, coupler, and attachments are in place, bolts, or cotter keys will be placed in the holes provided. Cotter keys will be opened wide and bolts peened over to prevent nuts from working off.

6-5. Maintenance

Established regulations of the Association of American Railroads (AAR) and the Department of Transportation (DOT) for the maintenance and inspection of freight and passenger cars contained In current AAR interchange rules are mandatory in interchange service on the railroads of the United States. Although it is not mandatory that Army personnel concerned with the maintenance of railway freight and passenger cars in oversea areas comply strictly with these regulations, it is recommended that they be used as a guide, particularly from a safety viewpoint.

6-6. Draft Gear for Oversea Equipment

The discussion on draft gears in paragraphs 6-1 through 6-3 is applicable to railroad equipment in the continental United States, Canada, and Mexico. The draft gear described for these countries is designed to take both buff and draft shocks. Of the oversea areas believed to be strategically important, only China and Korea have equipment where this type is adaptable. In most other areas, only pull load is absorbed by the draft gear and buff is absorbed by side buffers set approximately 35 inches to each side of the centerline of the draft gear. The hook-and link coupler of European pattern and the WIllison coupler of Russian pattern are examples of the latter type (fig 7-5 and 7-9).

CHAPTER 7

COUPLERS

7-1. General

Automatic couplers such as the type E, in general use in North America, are completely automatic except for aligning the knuckle to receive the mating knuckle of the car to be coupled It is safely operated from alongside the car by raising the uncoupling lever. Type D and type E couplers can be rigged for either bottom or top operation, according to the location of the lock lifting device on the car. Type D couplers may be found on pre-1933 cars in CONUS, although they are no longer acceptable in interchange. They may be used on intrainstallation cars in CONUS and on US built equipment in other countries. Type H, swivel shank (tightlock) couplers are in general use only on passenger equipment All automatic couplers are similar in components and methods of operation. The working parts of D and E couplers are interchangeable; however, with the exception of the knuckle pin, no parts of the type H coupler are interchangeable with any other type, although the parts have the same names. As it is the most common CONUS type, only the type E is discussed in detail. The Willison coupler, used extensively in foreign areas, is also discussed herein.

7-2. Type D Coupler

The basic components consist of the body, knuckle lock, knuckle thrower, and knuckle pin (fig 7-1). These parts remain the same whether the coupler is top-operated or bottom-operated. If equipped for top operation, the lifter is used in addition to these parts. If the coupler is rigged for bottom operation, a lock lifter and toggle are used Pivot lugs provide a bearing for the lifter. Because of the similarity of these parts with like parts of the type E, only the latter type will be discussed herein.

7-3. Type E Coupler

a General. The type E coupler is the type D with many improvements and refinements. It Is so designed that only the actuating parts need to be changed in order to fit the coupler for either top or bottom (rotary) operation. The uncoupling lever is simplified and can be located in any position that is convenient to trainmen for easy operation. A typical type E coupler is depicted in figure 7-2.

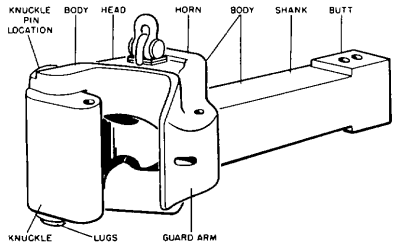


Figure 7-1. Typical type "D" coupler (rigid shank).

b Component Parts. Type E couplers consist of the following components, which function as indicated

(1) Body. This is the main section of the coupler It consists of the coupler head, the horn, the guard arm, the shank, and the butt. The coupler head houses the operating components.

(2) Knuckle. This is a rotating hook, hinged on the knuckle pin, held to a connection with a rotating knuckle by the knuckle lock.

(3) Lock. A key-shaped block which drops into place when the knuckle is closed. It prevents uncoupling.

(4) Knuckle thrower The device which throws the knuckle open when the uncoupling lever is raised.

(5) Knuckle pin. This acts as a pivot for the knuckle and holds the knuckle pin in the jaws of the coupler.

(6) Lifter The mechanism which is moved by the uncoupling lever to lift the knuckle lock and open the knuckle.

(7) Toggle. This works with the lifter and pivot lugs to provide a means of lifting the knuckle lock on

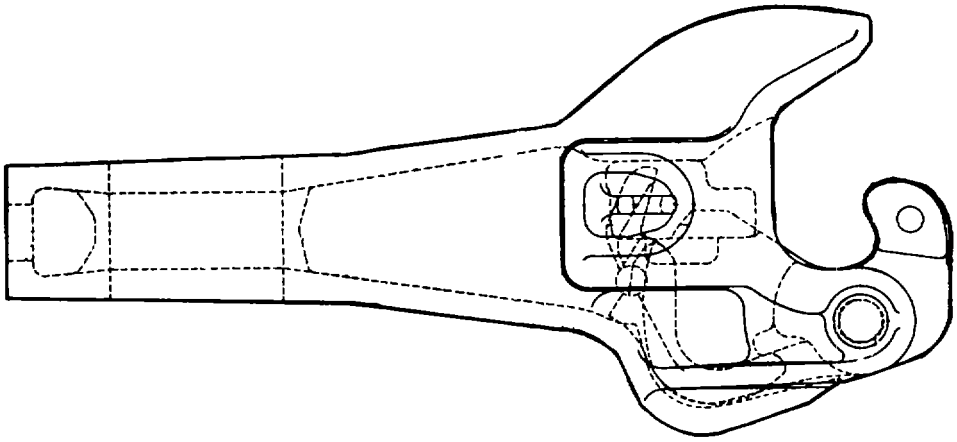


Figure 7-2. Typical type "E" coupler

c. Operation. To throw the knuckle (i.e., uncouple), the lock is lifted above its lockset position until the fulcrum on the forward side contacts the shoulder within the coupler head. This contact stops the vertical movement of the lock and forces it to rotate about its fulcrum, thus giving the lock key a positive movement to the rear. This rotates the knuckle thrower about its trunnions, and the lip of the thrower contacts the shoulder on the underside of the knuckle, throwing the knuckle open, or unlocking It, if coupled to another.

7-4. Tightlock Couplers

The type H or tightlock coupler, of entirely new design, incorporates a number of distinct new features. In outward appearance, it is similar to those discussed and consists of essentially the same named parts (para 7-2). Certain surfaces of the coupler head knuckle, lock and knuckle pinholes in both head and knuckle are machine finished to meet the close fitting tolerances required. In addition, aligning wings extend from both sides of the coupler head. These form a part of the head and provide increased coupling efficiency. This type of coupler is rotary-operated and normally operated from the left side of the car by a single-type lock-lift assembly. It can be adapted to a double-type lock-lift assembly for operation from either side. The principal advantages of this coupler design are the reduction of contour -slack, elimination of noise caused by coupler slack, the reduction of fatigue failures in the coupler face and knuckle wall, and elimination of buffing stresses. Since slack is reduced and resulting buffing and jolting is also reduced, the service lift of the coupler is increased.

7-5. Maintenance, CONUS-Type Couplers

a. General. Design specifications, requirements, and regulations will dictate when and what coupler maintenance action is to be accomplished. For CONUS-type couplers previously discussed, two of the more frequent requirements for maintenance are cited below. Familiarity with AAR rules and Army regulations, as well as with parts and their operational functions, is essential for good maintenance. Frequent inspections will detect defective parts. Couplers, types D and E with distance between point of knuckle and guard arm exceeding 5 5/16 inches as measured by gage (fig 7-3), must have the defective part or parts renewed to bring coupler within required gage of 5 1/8 inches as measured by gage (fig 7-4). If coupler is out of gage, the body must not be renewed unless the application of second-hand, reconditioned, or new knuckle lock and pin, any or all, will not bring it within the required gage of 5 1/8 inches.

b. Coupler Height. Coupler height must be maintained within the proper limits. The height of a coupler is measured from the top of the rail to the center of the face of the coupler knuckle. Empty freight cars with coupler heights measuring 32 1/2 inches or less will be adjusted to 34 1/2 inches. Loaded freight cars with coupler heights measuring 31 1/2 inches or less will be adjusted to, but will not exceed, 33 1/2 inches. When adjusting coupler heights, the coupler should first be placed in proper alinement with draft gear. Shim of 1/4-inch thickness or more, as required, may be applied to the carrier iron to adjust coupler height. If a shim less than 1/4inch thickness is required, realignment is unnecessary. After the coupler has been placed in

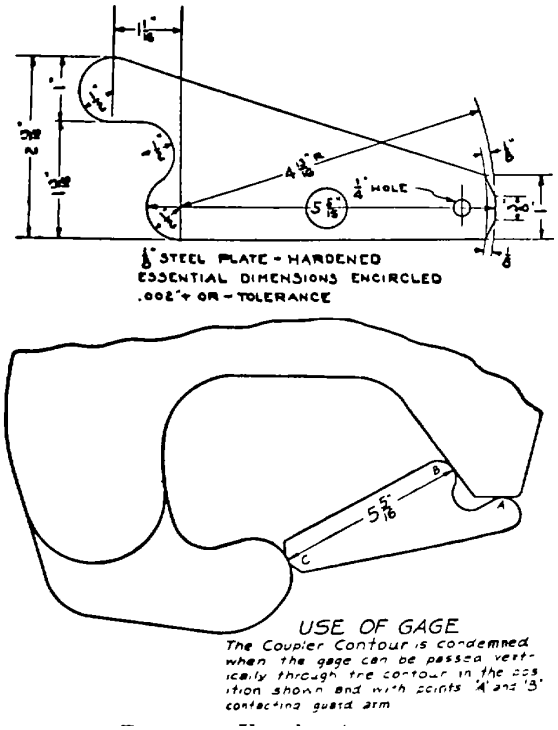

1 1/16"
1/4" HOLE
5 5/16
1/8" STEEL PLATE - HARDENED
ESSENTIAL DIMENSIONS ENCIRCLED
.005"± OR - TOLERANCE
USE OF GAGE
The Coupler Contour is condemned when the gage can be passed vertically through the contour in the position shown and with points 'A' and 'B' contacting guard arm

Figure 7-3. Use of contour gage.

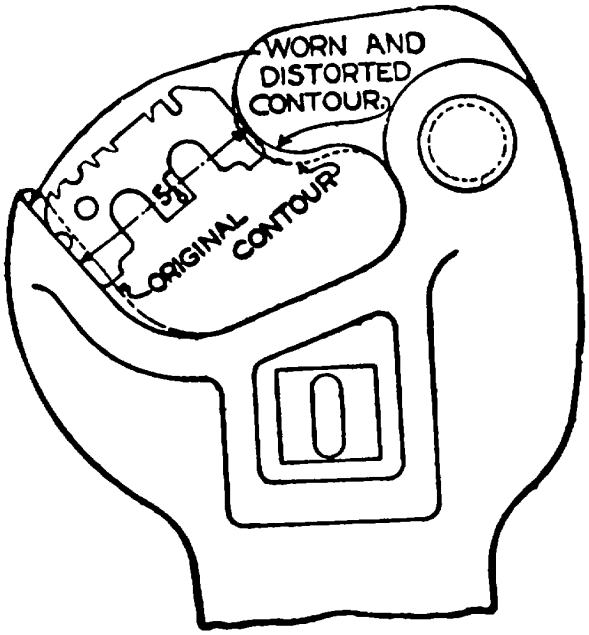


Figure 7-4. Use of worn limit gage.

proper alinement by shimming the carrier, if its height is not at least 1/2 inch in excess of the minimum dimensions specified above, further adjustments should be made at the truck springs, center plates, or journal boxes.

c. Knuckles. Excessive knuckle play, which ,often results from exceptional shock and jar in switching, may cause the guard arm of the coupler to be bent out of contour This can cause the opening of the knuckle to be out of gage and allow the knuckle of the coupler of an adjoining car to slip out. The distance between the guard arm and the knuckle should meet gage requirements, not to exceed 5 1/8 inches, as shown in figure 7-4. The knuckle opening may be exceptionally large. This condition may be corrected by building up (by welding) the knuckle where it makes contact with the lock fulcrum. However, a new coupler may be installed under these circumstances. If the excessive opening is due to a worn knuckle in the knuckle pinhole, replacement of the knuckle may be required A knuckle worn on the face or back bearings will be condemned by gagging. Such knuckles will be replaced. Knuckles are sometimes found cracked down the face. Such cracks are dangerous, and the knuckle
should be removed and replaced.

d. Knuckle Pins. Knuckle pins are frequently found defective. When replaced, pins of the proper size must be used. Larger pins might crack the pinhole casting, and smaller or undersized pins will become loose and will create slack, permitting the passing of the knuckle on the adjoining car between the knuckle and the guard arm. Cotter keys should not be used in knuckle pins except on fixed end gondola and hopper cars.

e. Slack. If any slack exists between the coupler butt and the follower plate or draft gear body, the cause should be determined and remedial action taken. Slack usually is caused by a worn coupler butt, but may be due to defective draft gear (chap 6). Worn coupler butts may be built up by electric welding or shim plates inserted to eliminate slack.

f. General Repairs. The rigid shank couplers in common use on Army rolling stock are attached to the draft gear yoke by draft keys inserted laterally through holes in the yoke and coupler shank or butt. It is supported underneath by a coupler carrier (iron) secured to, or part of the underframe, and a shim or wear plate between the carrier iron and the shank of the coupler. To remove the coupler, the following procedure is used (assembly is in reverse order):

(1) Disconnect the uncoupling lever from the coupler lock lifter.

(2) Remove knuckle pin and knuckle.

(3) Remove lock, lock lifter, and knuckle thrower.

(4) Remove cotter keys or bolts from draft key.

(5) Drift out the draft key from tapered end.

(6) Slide the coupler backward until two thirds out.

(7) Place a long bar or pipe immediately behind the coupler head, under the thickest portion of the shank, and with two men holding the bar or pipe in one hand, each side, using the other hand to balance the coupler, lift it out and lower to the ground.

(8) Remove yoke, draft gear, etc., as required (para 6-4b).

7-6. Couplers for Oversea Railway Equipment

With few exceptions, hook-and-link and Willison couplers set at 41 inches coupler height predominate in oversea areas. The exceptions are those areas such as Korea, Japan, and China where AAR-type automatic couplers are used. As stated previously, neither hook-and-link nor Willison couplers transmit buff directly to the center sill through draft gear. Buff loads are taken up by two side buffers at coupler height above the top of the rail. Each buffer is set approximately 35 inches off the longitudinal centerline of the car. Design loads are fixed for both buffers and the hook and links of the coupler. This design establishes the maximum drawbar pull allowed when fixing train tonnage's, and the useful life of the coupler is directly related to the amount of misuse brought about by overloading. One of the outstanding characteristics of the hook-and link coupler is that its design provides for no built-in slack between cars. Links are turned tight by turnbuckles, thus losing all slack. These two coupling devices are illustrated in figures 75 and 7-6. Figure 7-6 shows side buffer arrangement.

7-7. Hook-and-Link Couplers

a. General. The standard European coupler consists of three main parts on each end of the car. These parts are a screw coupling, a draw hook, and two buffer assemblies, illustrated in figure 7-. The draw hook forms a part of the underframe of the car. The screw coupling is mounted at the base of the hook. The two buffer assemblies are located one on each side of the hook and screw coupling toward the outer sides of the car, as shown. The screw coupling consists

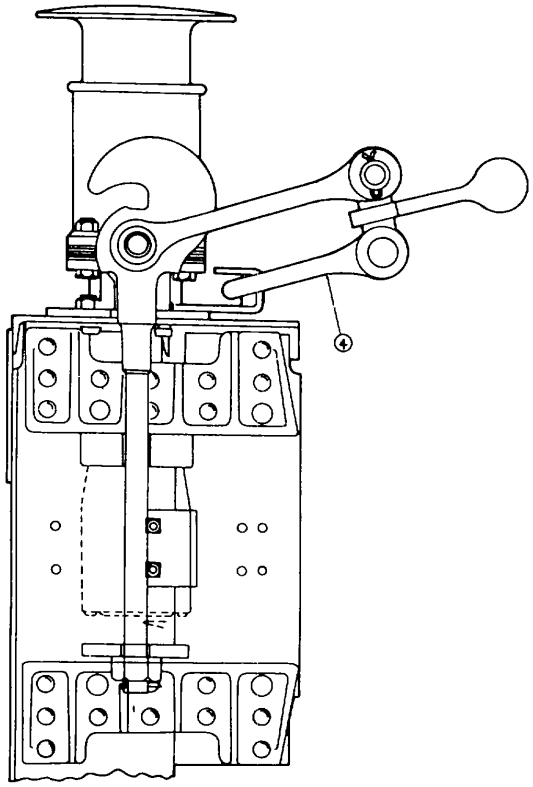


Figure 7-5. Hook and link (screw) coupler, buffer, and draft gear.

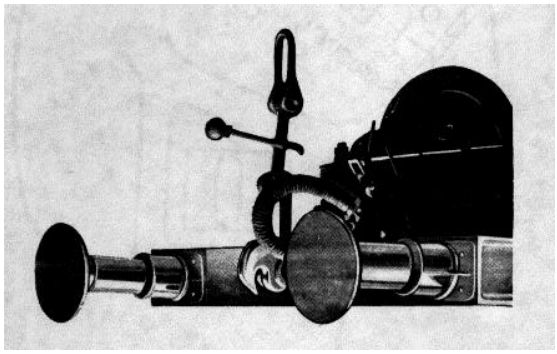


Figure 7-6. Side buffers

of the clevis, screw and lever, and the shackle. Each buffer assembly consists of a housing which is attached to the framework of the craft and in which is housed a spring-loaded section, extending out of the housing.

b. Operation. When cars are coupled, the shackle of the screw coupling on one car is

hooked over the draw hook of the other car; tightening of the lever tightens the screw and draws up the screw coupling The coupling is tightened until all slack is removed. The face of each buffer on the car should then be in contact with the face of the corresponding buffer on the other car. When the train is started or running, the screw coupling carries the pulling load. In running, stopping, and starting, the buffers protect the cars and lading by obstructing any jolts and shocks and preventing the cars from running together (the function of the draft gear in U. S. type equipment). On curves, the buffers on the side of the cars on the inside of the curve are passed farther into the housing The buffers on the outside of the cars extend from the housing because of the pressure exerted by the springs, thus they steady the car during runs. To uncouple, the screw coupling lever must be loosened by loosening the screw until there is sufficient slack to lift the shackle off the draw hook.

7-8. Willison Automatic Couplers

a. General. The Willison coupler, used in some oversea areas, is an automatic coupler which works on the same general principles as the standard AAR coupler used in the United States. It has one marked difference, that of being capable of coupling to the continental Europe Standard hook-and-link coupling by means of a transition device, the standard clevis and screw discussed in paragraph 7-7. The principal components, shown in figure 7-7, include the following: friction buffer (1); Willison coupler (2); buffer spacer (3); coupler support (4); draft gear and yoke (5); and transition device (6). The operating parts of two types of Willlison coupler are illustrated in figures 7-8 and 7-9.

b. Maintenance The operating parts illustrated in figures 7-8 and 7-9 are removable and accessible for maintenance The following steps are taken in the inspection of this type coupler:

(1) Visually inspect the operating parts of the coupler to see that they are not cracked or broken.

(2) Test uncoupling device for proper operation.

(3) Check all visible parts of the draft gear for cracks or damage

(4) Measure coupler height. Centerline of coupler should be 41 inches from top of rail. Buffer centerline must measure 42 inches from top of rail.

(5) Inspect friction buffers and transition screw device for loose, missing, or cracked parts.

c. Removal and Disassembly. The Willison type coupler is removed from a car in the following manner:

(1) Disconnect uncoupling rigging

(2) Support coupler weight and remove coupler support from coupler by removing the four holding nuts and bolts.

(3) Remove the coupler pivot pin retaining key through the cut-out hole provided in the side of the coupler and drop out the pin.

(4) Disconnect coupler from draft gear yoke and pull out to remove.

(5) Remove thrower arm bolt and nut

(6) Remove thrower, lock, and filler block.

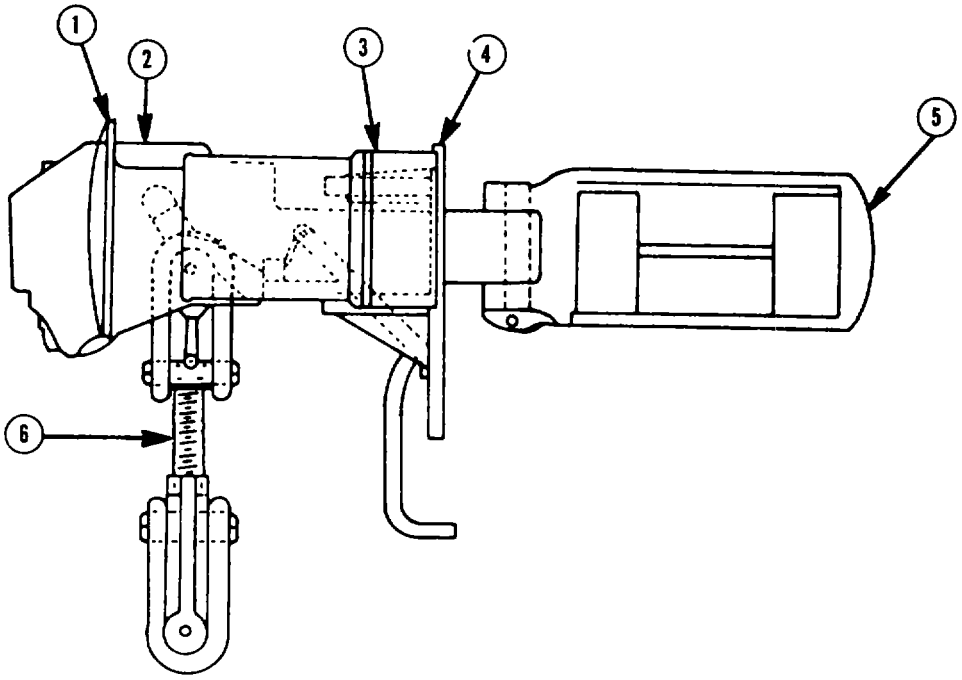
(7) Clean and inspect all parts for serviceability.

d. Reassembly

(1) Replace all damaged or worn parts.

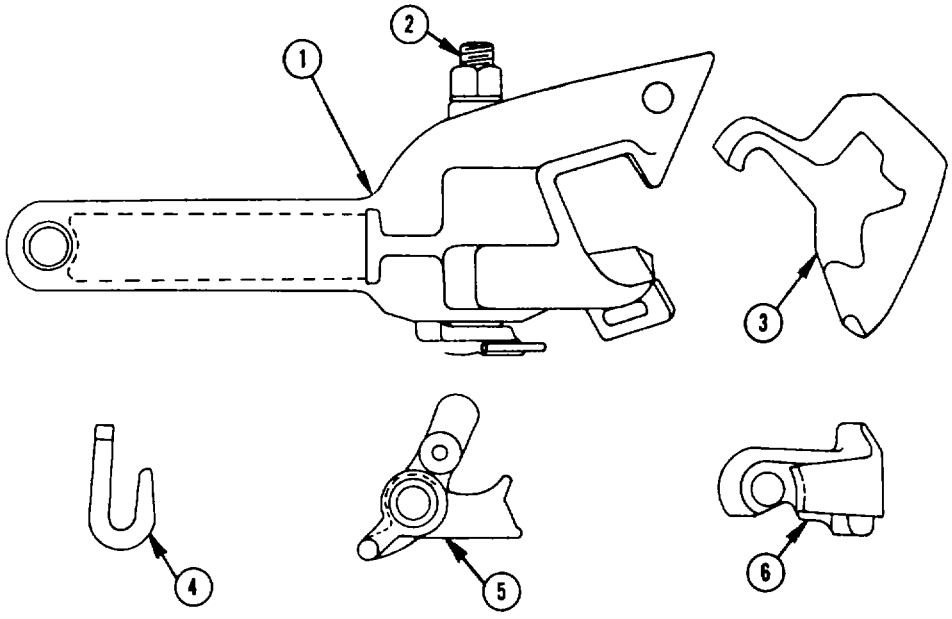
(2) Assemble and install parts in reverse order of removal.

(3) Gage coupler height when installation In the car has been completed. Adjust as required.



1 Friction buffer
2 Willison coupler
3 Buffer spacer
4 Coupler support
5 Draft gear and yoke
6 Transition device

Figure 7-7. Typical Willison arrangement.



1 Coupler
2 Thrower arm bolt and nut
3 Lock
4 Support hook
5 Thrower
6 Filler block

Figure 7-8. Operating parts, type E, Willison coupler.

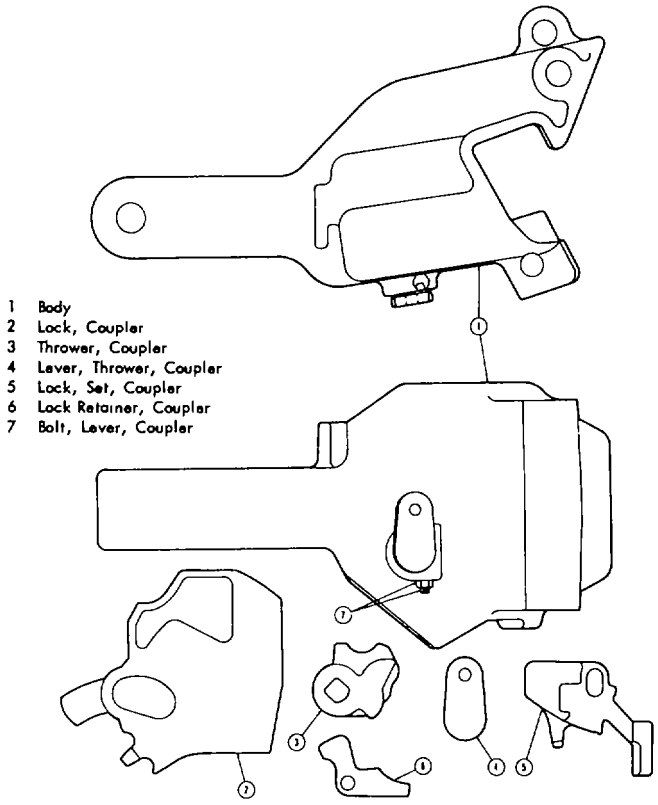


Figure 7-9. Operating parts type L, Willison coupler.

CHAPTER 8

CAR BRAKE EQUIPMENT

Section I. CAR TRUCK BRAKE GEAR

8-1. General

a. Brake gear is the whole combination of parts on a car or train which, when working together, slow down or stop the motion of the car or train These parts include the foundation brake system. On many oversea railways, a vacuum brake system is used in lieu of the standard airbrake system found in the United States.

b. A truck brake assembly includes those parts of the foundation brake gear that are secured directly to the truck. It includes the truck live lever, bottom connecting rod, bottom brake rod and brake beam safety supports, truck dead lever, dead-lever fulcrum, brake beams, brake beam heads, brakeshoes, and all keys, pins, etc, needed to make the assembly complete (fig 4-29). The dividing point is the connection of the truck live lever with the remainder of the foundation gear.

c. Foundation brake gear parts, including those parts known as truck brake gear parts, are standardized by regulations and specifications Required braking ratios are fixed by Association of American Railroad (AAR) regulations which are strictly adhered to. These regulations are incorporated in Department of the Army specifications for all railway equipment for both oversea and domestic service.

d. Certain railway equipment such as depressed center flatcars and exceptionally long passenger cars, such as circus train cars, because of low congested center sections on their underframes, require separate brake cylinders mounted on each truck for effective braking action in lieu of the conventional single body-mounted brake cylinder and foundation brake gear. This difficulty is circumvented by mounting complete and independent brake cylinders with foundation brake gear on each truck.

8-2. Foundation Brake Gear

a. General. The foundation brake gear (fig 8-1, 8-2) is defined as levers, rods, brakeshoes, brake beams, and similar equipment either secured directly to the car trucks or associated with the car trucks through component parts of the system. These parts connect the brakeshoes to the handbrake system and to the piston rod of the brake cylinder of the airbrake system. This connection is so made that, when the handbrake wheel is operated or the air pressure forces the piston out, the brakeshoes are forced against the wheels This action slows down or stops the car or train, depending upon its speed, the extent of brake application, and the frequency of application. Brake beams, brakeshoes, levers, etc., are illustrated in figure 4-29.

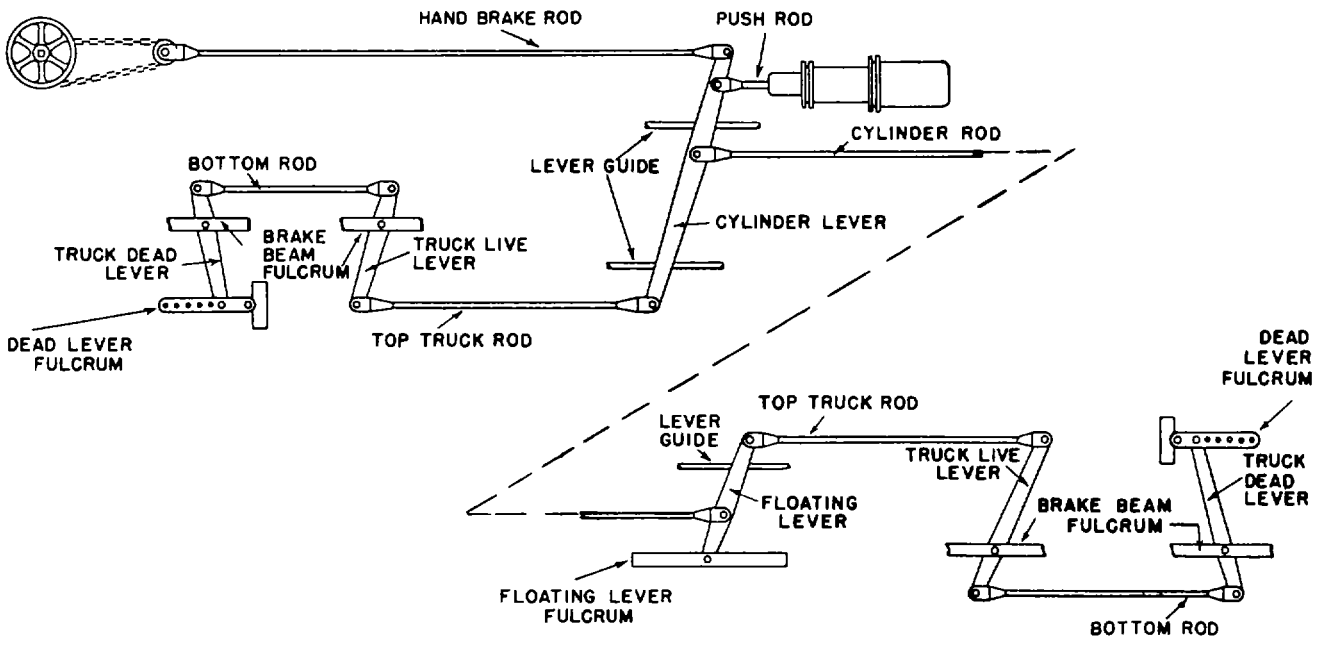
b. Brake Lever Badge Plate

(1) A standard badge and dimension plate showing the dimensions of the truck and body levers which are standard for each car was adopted by the Association of American Railroads in 1928.

(2) The badge plate (fig 8-2) is made of metal and fastened to the underframe of the car in an accessible place, preferably near the brake cylinder. This plate gives the proper dimensions of the levers for both the body and truck brake gear. After an approved badge plate has been applied to any car, levers will be checked to see that they conform to standard dimensions. These requirements are a part of the rules in effect on all railroads governing annual repairs to brakes on freight cars. If wrong levers are found, they will be replaced with levers conforming to the dimensions shown on the badge plate.

8-3. Brake Gear Regulators

a. General. Several types of brake gear regulators are in use on freight cars. These regulators take up slack manually in the brake gear to adjust piston travel. Automatic slack adjusters (fig 8-3) must be properly regulated each time piston travel is adjusted to insure that sufficient takeup is available to maintain proper piston travel en



Note This illustration to be followed in reporting defects in handbrake rigging

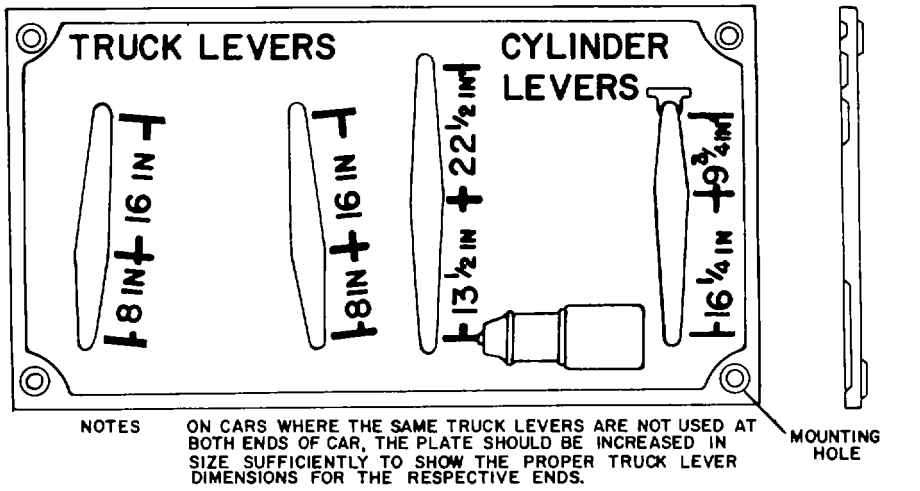
Figure 8-1. Foundation brake gear diagram.

route in service. Maintenance is described in paragraphs 16-7 and 8-19. Three of these regulators are described below.

b. Type 1. One type is provided with a notched pull rod at each end of the car which is connected to the dead lever. To adjust piston travel: pull straight on the handle which is located on the right side of the coupler and let go. A pawl on the notched pull rod locks when the rod is pulled as far as it will go. Then go to the opposite end of the car and repeat the operation. To release slack to change brakeshoes, pull handle, then give it 1/8 turn to right, then push back all the way. This gives maximum slack in the brake.

c. Type 2. Another type is provided with a rigging lever which extends in a horizontal position to a point near and just under the outer ledge of the car near the center, or in some applications on hopper cars it is located at one end. The lever actuates a notched square bar, which has a pawl underneath the bar, engaging the notches. A single lever serves to take up slack on both trucks. To adjust piston travel: pull the handle of the lever as far as it will go, then release. To release slack: push up pawl, then push back handle as far as it will go.

d. Type 3. A third type is provided with a rotating square shaft, which is placed in a horizontal position under the car body, extending out under the outer sill of the car. Two holes are drilled through the end of the square shaft. A short bar can be inserted in the hole on any of the four sides. A pawl wheel is 'placed on the shaft, and the direction -to turn shaft to take up slack is indicated by an arrow on the housing inclosing the pawl wheel. To take up slack: insert a short bar in hole in end of shaft, and turn shaft in direction indicated by arrow as far as it will go, then release. To release slack: release pawl and turn shaft as far as it will go in opposite direction. Adjustments for this type are shown in figure 8-4.


TRUCK LEVERS
CYLINDER LEVERS
18 IN
16 IN
18 IN
16 IN
13½ IN
22½ IN
16¼ IN
9¾ IN
NOTES
ON CARS WHERE THE SAME TRUCK LEVERS ARE NOT USED AT BOTH ENDS OF CAR, THE PLATE SHOULD BE INCREASED IN SIZE SUFFICIENTLY TO SHOW THE PROPER TRUCK LEVER DIMENSIONS FOR THE RESPECTIVE ENDS.
MOUNTING HOLE

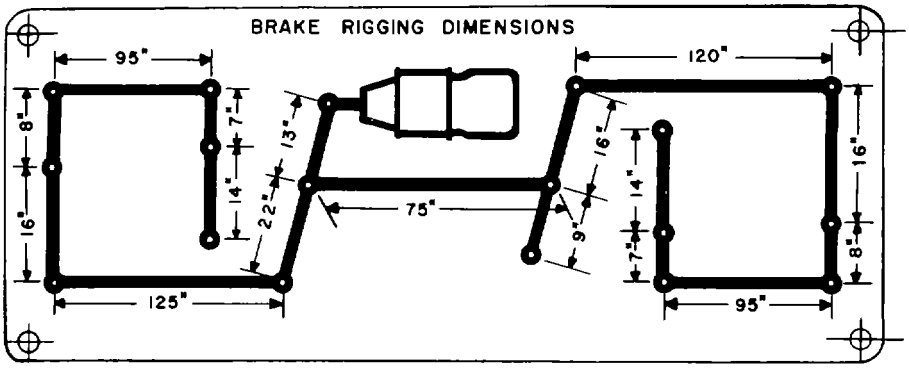
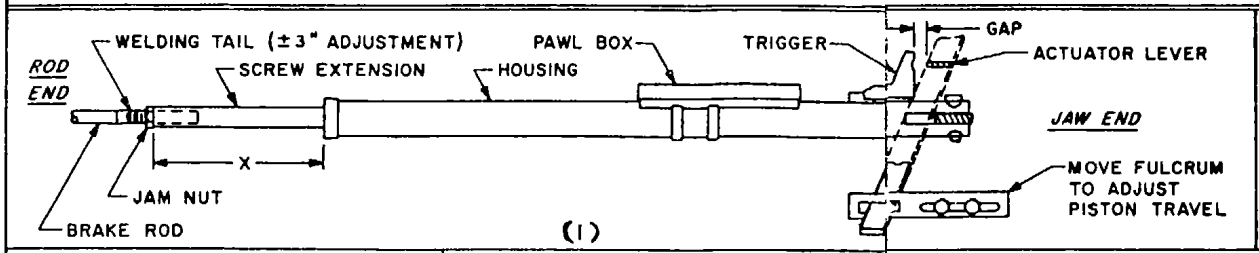
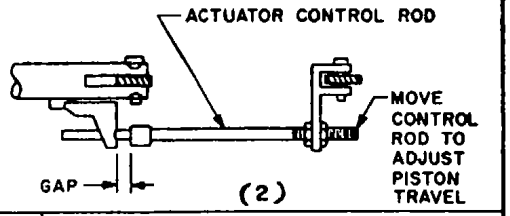


Figure 8-2. Typical brake lever badge and dimension plate.

THE A B C OF BRAKE RIGGING ADJUSTMENTS FOR THE MODEL 1480 BRAKE REGULATOR





WHAT TO DO IF	SEE
. PISTON TRAVEL IS LONG	B,C2
PISTON TRAVEL IS SHORT	B,C2
. BRAKE SHOES NEED REPLACING. . .	A
DIMENSION "Y" IS INCORRECT	C1,B3
BRAKES CANNOT BE HOOKED UP BECAUSE OF INSUFFICIENT SHOE CLEARANCE . ..	C3
REGULATOR WILL NOT TAKE UP. . .	C2.
. REGULATOR WILL NOT LET OUT. . .	C2
UNIT HAS TO BE REPLACED.	C4.
. 2" BRAKE SHOES ARE USED TO REPLACE ORIGINAL 1½" SHOES. ...	A4.

NOTES

The Model 1480 Brake Regulator is a double acting, fully automatic, mechanical slack adjuster When CORRECTLY INSTALLED this device will maintain proper piston travel indefinitely. As shoes wear, unit will take up, and as shoes are replaced, unit will let out, automatically maintaining piston travel No manual adjustments have been provided on the regulator and none should be made on brake rigging, with one exception. When wheel changes are made bottom rods should be adjusted for proper truck lever angularity See SECTION C2.

SECTION A

HOW TO REPLACE BRAKE SHOES

1 To replace 1 or 2 shoes, remove old shoes, and apply new shoes DO NOT MOVE ANY BRAKE PINS

2 To replace more than 2 shoes, bar back brake head before removing any shoes & insert a block between shoe and wheel Apply brakes - by hand or air - and release Replace as many shoes as clearance will permit Block and repeat until all shoes have been changed DO NOT MOVE ANY BRAKE PINS

3 If 6 or 8 shoes are to be changed it may be quicker to disconnect the Actuating Lever - Fig 1, or Control Rod - Fig 2, in order to create all the necessary slack at one time
To do this proceed as follows .

a Remove actuator lever or control rod by removing brake pins
b REPLACE PINS TO CONNECT RIGGING
c Apply, and release, hand brake
d APPLY NEW SHOES
e REPLACE ACTUATOR LEVER OR ROD

4 2" brake shoes can be used in place or original 1-1/2" shoes without any manual adjustment in most cases
If screw extension, dimension "X", exceeds 19" it will be necessary to lengthen brake rod by backing out threaded welding tail - Fig 1 - but remaining thread engagement must not be less than 1-3/4"

SECTION B

HOW TO ADJUST PISTON TRAVEL

1 Piston travel is controlled by the gap, or space, between the trigger and actuator lever - Fig 1, or trigger and control rod - Fig. 2

BEFORE CHANGING ADJUSTMENT MAKE SEVERAL SERVICE BRAKE APPLICATIONS TO MAKE SURE PISTON TRAVEL IS INCORRECT. IF PISTON TRAVEL IS 7" TO 8-1/2" ON 10" DIA CYLINDERS, AND 5" TO 5-3/4" ON 12" DIAMETER CYLINDERS - WITH 50 PSI CYLINDER PRESSURE - DO NOT CHANGE SETTING (READ SECTION C2)

2 If adjustment is necessary SHORTEN piston travel by moving actuator CLOSER to trigger INCREASE pistor travel by moving actuator AWAY from trigge . The amount of movement should approximate the desired change in piston travel.

3 DO NOT ATTEMPT TO ADJUST PISTON TRAVEL BY MOVING BRAKE PINS.

a "TAKING UP" on brake rigging will not shorten piston travel but will cause SCREW EXTENSION - Fig 1 - to extend, making dimension "X" longer.

b "LETTING OUT" brake rigging will not increase piston travel, but will cause SCREW EXTENSION, - Fig. 1 - to take up, making dimension "X" shorter.

SECTION C

1 SCREW EXTENSION length "X" - Fig. 1- is an indication of the available takeup left in the regulator. With new shoes and wheels dimension "X" should be 17", plus or minus 1 inch. As shoes wear this automatically becomes less. As they are replaced "X" becomes longer NORMALLY NO MANUAL ADJUSTMENT IS REQUIRED.

2. If improper brake rigging adjustment has been made, or 2 in shoes applied in place of 1½" shoes, or M.W. wheels are turned down, screw extension may get out of adjustment

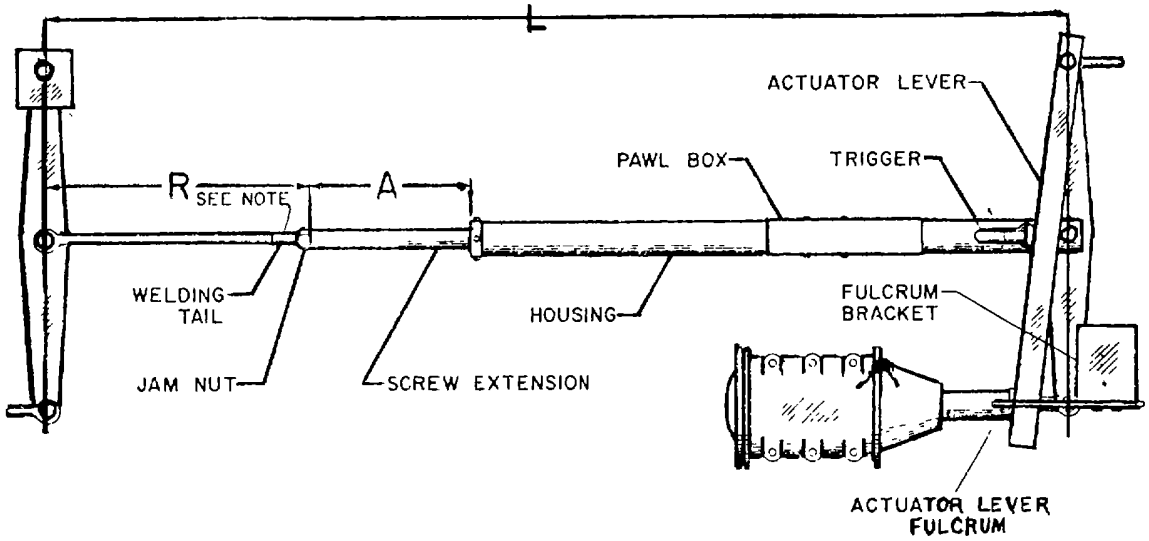
If "X" exceeds 19", piston travel may get short Adjust by "letting out" brakes. (See Section B3b).

If "X" reduces to 1" or less, piston travel may get long Adjust by "taking up" brakes. (See Sec. B3a).

3. If brakes cannot be hooked up because truck repairs have reduced shoe clearance, or because dimension "X" is too short, remove actuator lever (see Sec. A3), chain rod end to car structure and set hand brake.

If a "come-along" or ratchet puller is available, connect to screw or rod end, and pull out without disconnecting actuator lever.

Figure 8-3. Brakes regulator, automatic type.



Instruction plate placed on cars which have this type brake adjustor- Contains the instructions shown with this illustration.

Do not operate hand brake while brake rigging is disconnected from truck. If necessary to set hand brake for operational check first remove actuator lever.

When replacing regulator for any reason rod length "R", from pin hole to jam nut, must be maintained. Do not use dimension "L" as a reference as it varies with changes in "A".

Piston travel is determined by the location of the Actuator Lever Fulcrum and is permanently set at the original installation.

Screw extension, "A", indicates the amount of "take-up" remaining in the regulator at any time. On a car having new shoes and wheels, screw extension "A" should be between 16 and 18 inches (measured with brakes set.) As shoes wear "A" will decrease. As new shoes are installed 'A" will increase.

Moving brake pins or changing rod lengths will not change piston travel but will change "A". Therefore, when repairing car, rod lengths and pin locations must be maintained.

Figure 8-4. Brake regulator, manual type.

Section II. HANDBRAKES

8-4. General

a. Purpose. All railway cars must be equipped with a suitable means of slowing down or stopping the car by hand. When cars are being switched in yards, they are frequently in motion with no locomotive coupled to them and a handbrake is necessary if trainmen are to control these cars. There are many types of handbrakes, each of which must meet operational requirements. Handbrakes are illustrated and described in the following paragraphs.

b. Parts. The main requirements of a handbrake are that it must be capable of stopping a car and that it must operate in harmony with the airbrake Operating in harmony means that the handbrake can be used to operate the same foundation

brake levers and rigging as the airbrake. The handbrake will always be Installed on the B-end of the car; that is, the end toward which the brake piston moves. Usually, the handbrake is connected to the cylinder lever, adjacent to the brake piston connection or to some equivalent point. In general, handbrake equipment consists of a handwheel (or hand lever), a handbrake shaft, and handbrake connections which include rods and chains connecting the handbrake shaft with the brake levers. In some cases, other parts, such as gears, pawls, and a bellcrank, are also used.

c. Types. Hand-operated brakes include the ordinary, straight-shaft handbrake equipped with a handwheel at the top, which is turned to wind the brake chain on or off the lower end of the shaft (fig 8-5); the ratchet type of brake, in which a lever and ratchet are employed instead of the ordinary handwheel; the drum or cone type, which employs a ratchet device; the geared brake, which has gears that assist in the application of power (fig 86); and the screw type, in which the brake shaft is turned by means of a screw or worm and a gear and the brake is applied by means of a crank or toggle.

d. Classification. The types of handbrakes in use on cars can be further classified as either horizontal or vertical The designation used will depend upon the position of the handwheel. For example, with a geared-type, if the handwheel (fig 8-7) is horizontal, the handbrake will be designated as a horizontal geared-type handbrake; if the handwheel is vertical, as a vertical gear-type Figure 8-8 illustrates a vertical lever-type, geared handbrake. This type is designed for mounting on the ends of gondola freight cars. Figure 8-6 illustrates a vertical, wheel-type, geared handbrake. With a horizontal-type brake, it is possible to transmit the braking force directly from the hand-wheel to the vertical shaft, as evidenced by the straight-shaft type of equipment. However, with a vertical-type, since the braking force is applied initially in a horizontal direction, some medium, such as gearing, is necessary to change the direction of the force from horizontal to vertical so as to transmit it to a point below the level of the underframe.

e. Use. With a horizontal brake, as mentioned above, the braking force is initially in a vertical direction and can be transmitted to the bottom of the car by a vertical shaft. If a geared-type horizontal handbrake is used, the braking force will still generally be transmitted through a vertical shaft. However, with a vertical brake, when the direction of the application of force changes from horizontal to vertical, a length of chain connected to a vertical shaft normally is used to transmit

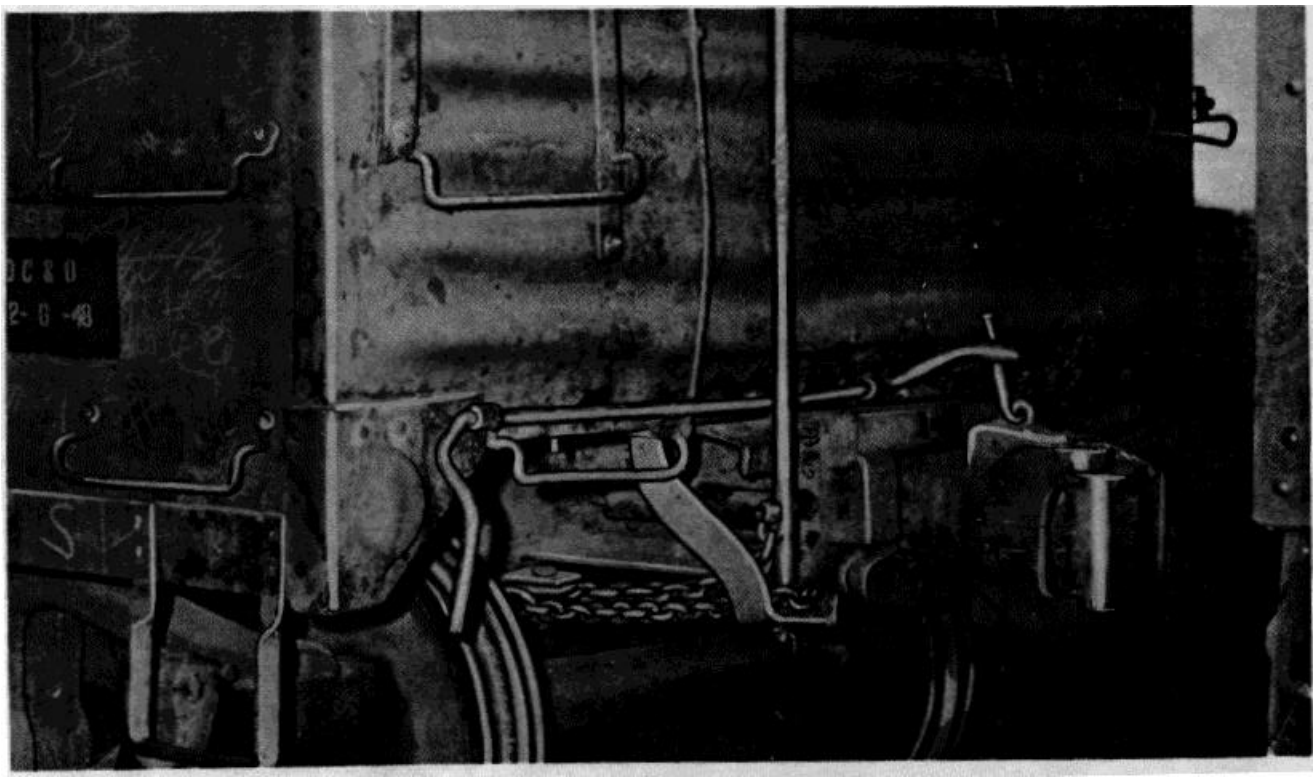


Figure 8-5. Straight shaft handbrake.

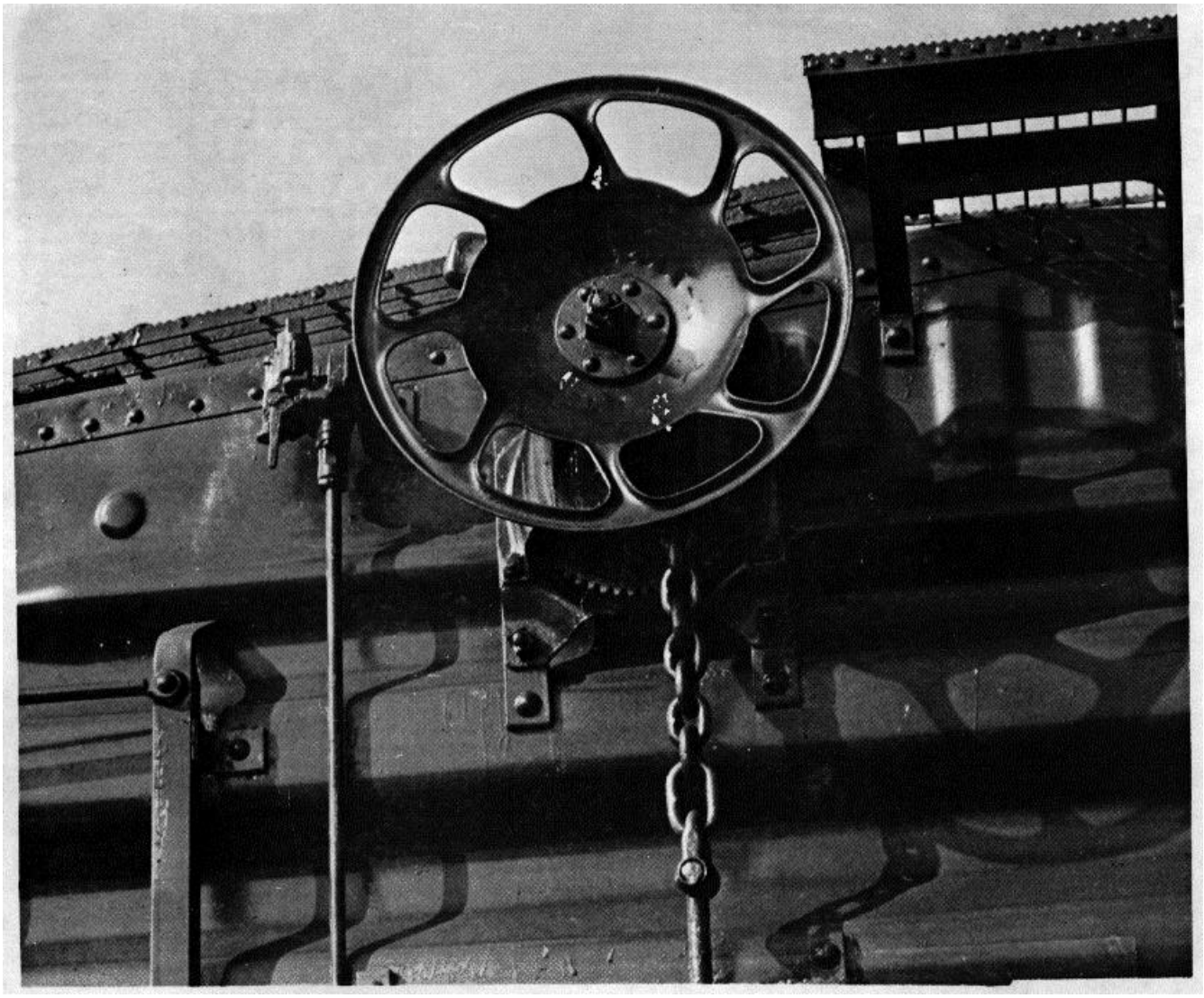


Figure 8-6. Vertical geared-type handbrake, 50-ton USA boxcar, showing retainer valve.

the braking force beneath the car. When the straight shaft is used, it will rotate as the handwheel is turned. When the chain is used, it will rise upon brake application and wind on a small shaft or drum or it will lower upon brake release, thus unwinding. When the braking force reaches a point below the level of the underframe, it must change direction to connect to the foundation brake rigging levers and rods and thus operate the brakeshoes.

8-5. Design

a. Early Straight-Shaft Design. The straightshaft design consists of a handwheel or hand lever, a shaft running vertically along the end of the car and anchored to a bracket on the underframe, and the horizontal brake chain fastened to the end of the vertical shaft. A gear and pawl, usually near the top of the vertical shaft, prevent the equipment from backing off. When the hand- wheel is turned to apply the brakes, the shaft and the gear turn, and the pawl engages each tooth of the gear, preventing backing off. Simultaneously, the horizontal brake chain winds around the turning shaft and applies the brakes. To release the brakes, the pawl should be disengaged and the handwheel turned in the opposite direction to permit the chain to unwind from the vertical shaft. A variation of the straight-shaft type, embodying the same principle as the gear type, is to have the end of the shaft anchored to the under-

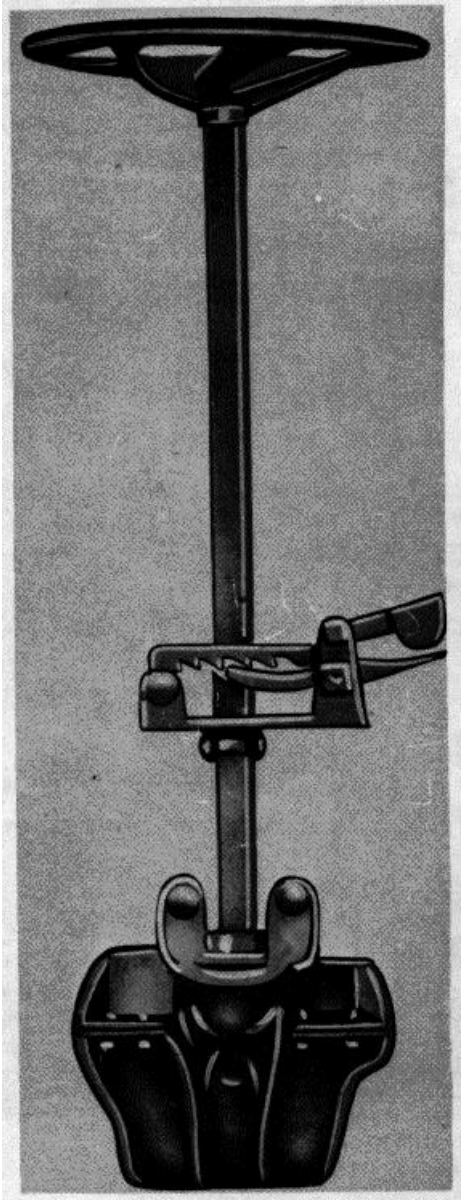


Figure 8-7. Typical horizontal-type handbrakes.

frame, with a spur gear installed on the shaft. Sometimes the shaft may be bent to such an extent that the brake will be inoperative. When a bent shaft is noticed, the brake should be tested to see whether the bend is prohibitive Also, where the chain winds around the shaft, the chain must be properly secured at the bottom to the underframe. The ratchet wheel and pawl, where exposed, should be inspected to see that both the wheel and pawl are secure, that they operate properly to hold the brake in any position, and that the brake releases properly when the pawl is released.

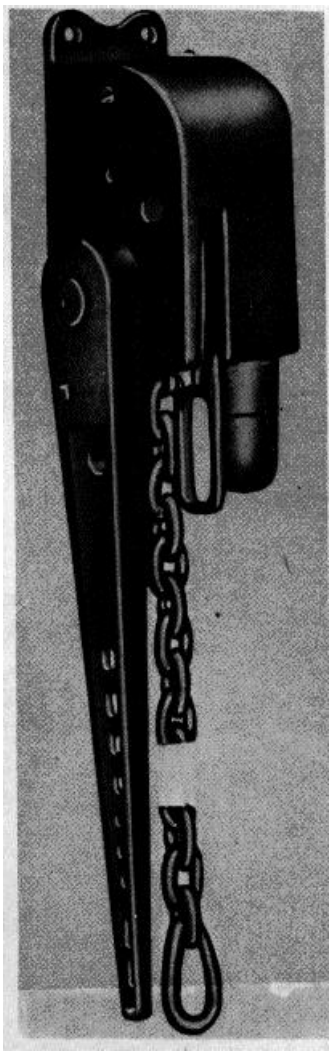


Figure 8-8. Vertical, lever-type, geared handbrakes.

b. Geared Handbrakes. Geared handbrakes are of three types-horizontal, vertical, and lever. All types operate in a similar manner. The handbrake operates in harmony with the power brake, and the design is such that, when force is applied to the brake cylinder lever at the brake piston connection, it permits a movement of not less than 14 inches. Also, when the brake piston is in full-release position, there is no excess slack in the handbrake chain or in other connections. The brake wheel and drum are arranged so that both revolve when the handbrake is applied or gradually released. Standard 9/16-inch hand chains or minimum 3/4-inch-diameter rods are used.

8-6. Maintenance

a. Lubrication. When cars are on shop or repair tracks for periodic attention to airbrakes, the geared handbrake mechanism and connections

must also be inspected, tested, and lubricated. Brakes found inoperative because of a lack of lubrication will be cleaned to permit oil or grease to reach the movable parts.

b. Mechanical Causes. When the brakes are found to be inoperative because of mechanical causes, the defective parts must be removed and replaced. Brakes that cannot be repaired at shop or repair tracks or those removed from demolished cars should be sent to reclamation points. Parts of one type of brake should not be used to replace parts of another type.

c. Welding or Brazing. Welding or brazing mechanical parts of geared handbrakes is prohibited. However, worn holes or pads on front and rear housing plates may be built up by electric welding to provide a proper seating for bushings or collars. Bushings may be tack welded to front or rear housing plates to prevent loss or turning and wearing of larger holes in either plate.

d. Chain. Vertical and horizontal handbrakes chains should be inspected to insure that they are securely pinned or anchored at each end to their respective operating parts Any loose connections should be remedied immediately. Careful inspection should be made to see if handbrake chains or connections are dragging on car axles, and corrective action taken. The constant contact and movement of handbrake chains resting on car axles result in chains being worn through, as well as the abrading of axle surfaces. This situation can be dangerous, particularly on tank cars loaded with flammable materials.

e. Bellcrank. If the particular handbrake system employs a bellcrank, the bellcrank must be secure and should pivot freely. The bracket holding the bellcrank must also be secure. If the bellcrank is bent, it might possibly be straightened without impairing its operating efficiency. However, if the bend is pronounced or if the bellcrank is cracked or broken, the crank must be removed and replaced with a new one. Where a small chain shaft secured in a bracket fastened to the underframe is used, a gear on the small shaft meshes with a gear on the vertical brake shaft. These gears should be inspected for proper mesh, cracked or broken teeth, and cracked or broken gears. The gears must be properly fastened to the respective shafts, and the shafts themselves should be secure and not bent, cracked, or broken. A cracked or broken shaft will eventually damage the gears and gear teeth, thus making the handbrake inoperative. Any damage to shaft or gears should be immediately remedied by repair or by replacement with a new part.

f. Connection to Foundation Brake Rigging. At the point where the handbrake equipment connects to the foundation brake rigging, a little play must be present to allow for leverage; free movement while the car is moving; and free, easy movement when the handbrake is applied.

g. Gears and Gear Housing. The gear housing must be held securely in position on the car. Any missing or loose holding parts must be tightened or replaced. The handbrake should be operated to see whether there is any stiffness or extreme slack in its operation. If there is evidence of either, it must first be determined that the cause is not in some other part of the equipment. If no ,other defect can be located, the gearbox should be opened and its parts inspected. Any badly worn or damaged parts should be replaced. Any loose parts should be tightened. Frequently, when defects are located in the gear housing, the best procedure is to remove the entire housing from the car, install a new housing, and send the defective one to the shop for repairs.

h. Safety Appliances. All appliances such as brake steps, hand holds, brake wheels, ratchet pawls, etc., required for the safe and proper operation of handbrake equipment must be inspected frequently. Any defects must be remedied immediately.

Section III. AIRBRAKES

8-7. Principles of the Airbrake System

a. General. The term airbrake refers to the type of brake in which compressed air is used to cause the brakeshoe pressure. Airbrakes are used (in rail service) to prevent the movement of cars or locomotives, and when in motion, to control the speed or stop them as desired. These results are obtained through the friction or holding force resulting from pressing the brakeshoes against the wheel tread or disc faces, which in turn is resisted by the friction of the wheel on the rail, caused by the load or weight on the wheel. The AB freight brake equipment is used on freight cars operating in interchange in the United States. On oversea railroads, single-capacity, (K type) freight car brake equipment (some cars have no airbrakes) and vacuum brake equipment are the most common types of equipment. Personnel who have anything to do with train handling and the maintenance of equipment,

either directly or indirectly, must thoroughly understand the elementary functions and operating principles of airbrakes. Such an understanding is the largest contributing factor to safety and economy and the prevention of loss of life or damage to railroad rolling stock and lading.

b. Operation. The necessity for accurate and positive control of railway trains requires the use of efficient brakes and has led to the development of the modern airbrake. The use of airbrakes is compulsory on American railways, and this apparatus has been developed to a high state of efficiency. The term airbrakes includes any brake operated by air pressure, but usually is restricted to systems of continuous brakes operated by compressed air as generally used in American railway practice to distinguish them from vacuum brakes. Air is compressed by a pump on the steam locomotive or by a motor compressor on electric or internal-combustion locomotives or cars stored in reservoirs, and is conveyed by pipes and flexible hose between the cars to cylinders and pistons under each car. Under the cars the pressure is transmitted to the brake levers and thence to the brakeshoes. The brakes are applied by reducing the pressure in the brake pipe below that in the auxiliary reservoirs. Such a reduction is caused when the engineman opens the brake pipe to the atmosphere through the brake valve, or accidentally when a hose bursts or a pipe breaks. The brakes are *released by admitting* compressed air from the main reservoir on the locomotive through the brake valve into the brake pipe, thus increasing the air pressure above that remaining in the auxiliary reservoir.

8-8. Principal Parts of the Automatic Brake

a. A power-driven air compressor, which supplies compressed air for use in the brake and signal system.

b. A governor, which controls compressor operation and regulates the air pressure maintained in the main reservoir.

c. Main reservoirs, which serve three purposes:

(1) To receive and store the compressed air.

(2) To act as a cooling chamber for the compressed air and as a catch basin for moisture and oil which is passed from the compressor and precipitated from the air by cooling.

(3) To act as a storage chamber for express pressure for operating other air-using devices without interfering with brake pipe pressure, and to serve as a backing volume or driving head of excess pressure for the purpose of releasing the brakes and recharging the airbrake system.

d. Two duplex gages (located in locomotive cab), one indicating main reservoir and equalizing reservoir pressure, the other, brake pipe and brake cylinder pressure. In addition, on dieselelectric passenger locomotives with high-speed control brake equipment, another single pointer gage in the cab shows control pipe pressure, while a single pointer gage in the engine-room of each unit shows main reservoir pressure. On diesel-electric freight locomotives with No. 8 EL equipment, three duplex air gages are located in the cab, one indicating main reservoir and equalizing reservoir pressure, a second indicating brake pipe and locomotive brake cylinder pressure, and a third indicating application and suppression pipe pressure. A single pointed gage indicating main reservoir pressure is located in the engineroom of each unit.

e. An automatic brake valve (located in locomotive cab), which regulates the flow of air from the main reservoirs into the brake pipe for releasing the brakes and from the brake pipe to the atmosphere for applying the brakes. A feed valve controls and reduces main reservoir pressure passing through the brake valve to the brake pipe in running position of the automatic brake valve.

f. A brake pipe (including branch pipe, flexible hose, and couplings), which connects the locomotive automatic brake valve and the conductor's valve with the brake control valve on each car. Angle cocks are provided at each end of every car for opening or closing the brake pipe at any desired point in the train. Cutout cocks are located in the branch pipe or crossover pipe to the brake control valve under each car to cutout individual brakes.

g. A brake control valve on each car to which the brake pipe, auxiliary reservoir, brake cylinder, and pressure retaining valve are connected, which performs three functions: first, to charge the auxiliary reservoir from the brake pipe; second, to admit air from the auxiliary reservoir to the brake cylinder to apply the brake; and third, to exhaust air from the brake cylinder to the atmosphere to release the brake. The AB type brake, used on freight cars operating in CONUS, is provided with an additional valve and reservoir which are used to provide additional braking power in emergency situations.

h. An auxiliary reservoir (also an emergency reservoir with the AB type brakes) on each car in which compressed air is stored for applying the brakes.

i. A brake cylinder or cylinders on each car, provided with a piston rod connected with the brake levers in such a manner that when the piston is moved by air pressure the brakes are applied.

j. A pressure-retaining valve that permits the brake cylinder air to be freely exhausted to the atmosphere or retards the exhaust of air from the brake cylinder down to a predetermined pressure and then retains that amount.

8-9. Definition of Term Used

a. Increase In Brake Pipe Pressure. When air is passing into the brake pipe more rapidly than it is escaping, so as to produce a rise in pressure (brake pipe pressure increase), it will move the control valves to release position.

b. Maintaining Brake Pipe Pressure. With the automatic brake valve in running position, air is being supplied to the brake pipe as fast as it is escaping. The feed valve automatically supplies brake pipe losses.

c. Brake Pipe Reduction. Air is escaping or being discharged from the brake pipe faster than it is being supplied through the brake valve, or feeding back from the auxiliaries. Losses from the brake pipe that are not being supplied will constitute a brake pipe reduction and tend to cause the brake control valves to move toward application position.

d. Lap. This term designates the position of the locomotive brake valve and brake control valves or distributing valve, in which all operative parts are closed to the passage of air.

e. Brake Application. A sufficient reduction of brake pipe pressure (no matter how made) to cause the brake control valves, or distributing valve, to move to application position. If made with the locomotive brake valve in service position, it may consist of one or more reductions with brakes remaining applied.

f. Service Application. A quick, heavy reduction of brake pipe pressure so as to cause the brake control valves to move to service application position. This condition is accomplished by the locomotive engineer for an expected stop or slow down or when a gradual reduction is made with the conductor's valve or tail hose.

g. Emergency Application. A quick heavy reduction of brake pipe pressure which will cause the brake control valves to move to emergency position and transmit quick action. This condition is accomplished when the locomotive brake valve is placed in emergency position, or by the trainmen with the conductors valve or tail hose. It is also made automatically when the brake pipe is broken or when the train parts.

Section IV. AB FREIGHT BRAKE EQUIPMENT

8-10. General

a. In 1926, the Association of American Railroads in cooperation with the Interstate Commerce Commission inaugurated a series of tests of various types of airbrake equipment for freight train brakes. Rack tests were followed by road tests. These resulted in adoption of an approved freight brake which has been given the designation AB. Additional equipment now available includes:

(1) AB-1-B brake equipment for highspeed freight or passenger service.

(2) AB-4-12 brake equipment for heavy freight cars.

(3) AB Automatic Empty and Load brake equipment used generally on high-capacity gondola and hopper cars operating primarily in coal or ore service where they operate empty or fully loaded.

b. The performance and maintenance of the AB-4-12 and the AB Automatic Empty and Load brakes are practically the same as the AB brakes with minor variations. Therefore, only the AB and AB-1-B brakes will be covered in the following paragraphs.

8-11. Description

a. AB Freight Brake. The AB freight brake was developed to keep pace with other major improvements. All of the good operating features of the standard brake have been retained and other valuable ones added. The AB brake has been adopted by the Association of American Railways (A.A.R.) as standard freight brake. Following are some of the approved features in the AB brake that were not included in the K freight brake.

(1) *Improved quick service.* The three stages of quick service provide a prompt and positive brake application on all cars of long modern trains.

(2) *Improved release.* In case of excessive slide valve friction that may delay release (or cause a struck brake), a release insuring valve

automatically releases the brake by reducing auxiliary reservoir pressure.

(3) *Rapid recharge.* A rapid increase of brake pipe pressure is obtained when release is started by using the emergency reservoir (which remains fully charged during a service application).

(4) *Improved emergency.* Undesired emergency during service application is eliminated by separation of the parts controlling the service and emergency portion.

(5) *Emergency brake cylinder pressure.* Emergency brake cylinder pressure approximately 20 percent higher than that obtainable from a full service brake application.

(6) *Speed of emergency.* Speed of emergency through the train is approximately 40 percent faster than the former standard freight brake.

(7) *Development of emergency pressure.* Development of emergency brake cylinder pressure in steps at a controlled rate prevents damaging shocks. Emergency pressure is available at all times.

b. AB-1-B Freight Brake. The AB-1-B brake is the same as the standard AB brake equipment with the addition of a filling piece with a selector valve portion, which is applied between the pipe bracket and emergency portion of the AB control valve. The service and emergency portions are standard in all respects to the AB control valve, but the studs holding the filling piece and emergency portion to the pipe bracket are longer than standard.

8-12. AB and AB-1-B Brake System Components

The components for both the AB and AB-1-B brake systems are the same unless otherwise noted:

a. AB Control Valve (used with AB brakes). The AB valve (fig. 8-9) consists of the following components:

(1) *A pipe bracket,* which is permanently mounted on the car and carries the pipe connections so that no pipes need to be disconnected to remove a valve portion. It also contains a removable hair strainer to keep foreign matter out of the valve portions.

(2) *The service portion,* which controls the charging of the reservoirs and the service application and release of brakes.

(3) *The emergency portion,* which controls the quick-action feature, high brake cylinder pressure, and the accelerated emergency release function.

b. AB-1-B Control Valve (used with AB-1-B brakes)

(1) The AB-1-B control valve is the same as the standard AB control valve except for the addition of a filling with selector valve portion and longer emergency portion bolting studs. The filling piece is bolted on between the pipe bracket and the emergency portion.

(2) A safety valve is provided on the selector valve portion which limits brake cylinder pressure for severe brake applications, but is closed off from the brake cylinder in emergency. The proper setting for the safety valve is 60 pounds.

(3) A connection is made from the signal line to the filling piece which automatically adjusts the selector valve for either passenger or freight service. When operated in passenger service, signal pressure automatically adjusts the selector valve to provide a direct build-up of emergency brake cylinder pressure.

(4) When operated in freight service, the absence of signal line pressure automatically adjusts the selector valve to provide the standard three-stage development of emergency brake cylinder pressure.

(5) In service braking the operation of this equipment is the same as the AB equipment.

c. A-2-A Quick-Service Valve (When Equipped). The A-2-A quick-service valve (fig 8-10) insures prompt brake pipe reduction and positive brake application.

d. Brake Cylinder (Fig 8-11)

(1) The brake cylinders are equipped with a piston and rod connected through the brake levers, brake rods, and brakeshoes. When the piston is forced outward by the air pressure, force is transmitted through the rods and levers applying the brakeshoes to the wheels. A release spring forces the piston to the release position when air pressure is exhausted from the opposite end of the cylinder. A packing cup presses against the cylinder walls and prevents the escape of air past the piston.

(2) Periodic cleaning, oiling, and testing of the brake cylinder is performed without removing the cylinder from the car.

e. Combined Auxiliary and Emergency Reservoir. The auxiliary and emergency reservoirs are combined into one unit (fig. 8-12) which is divided into two compartments. One serves as storage for auxiliary air pressure and the other for

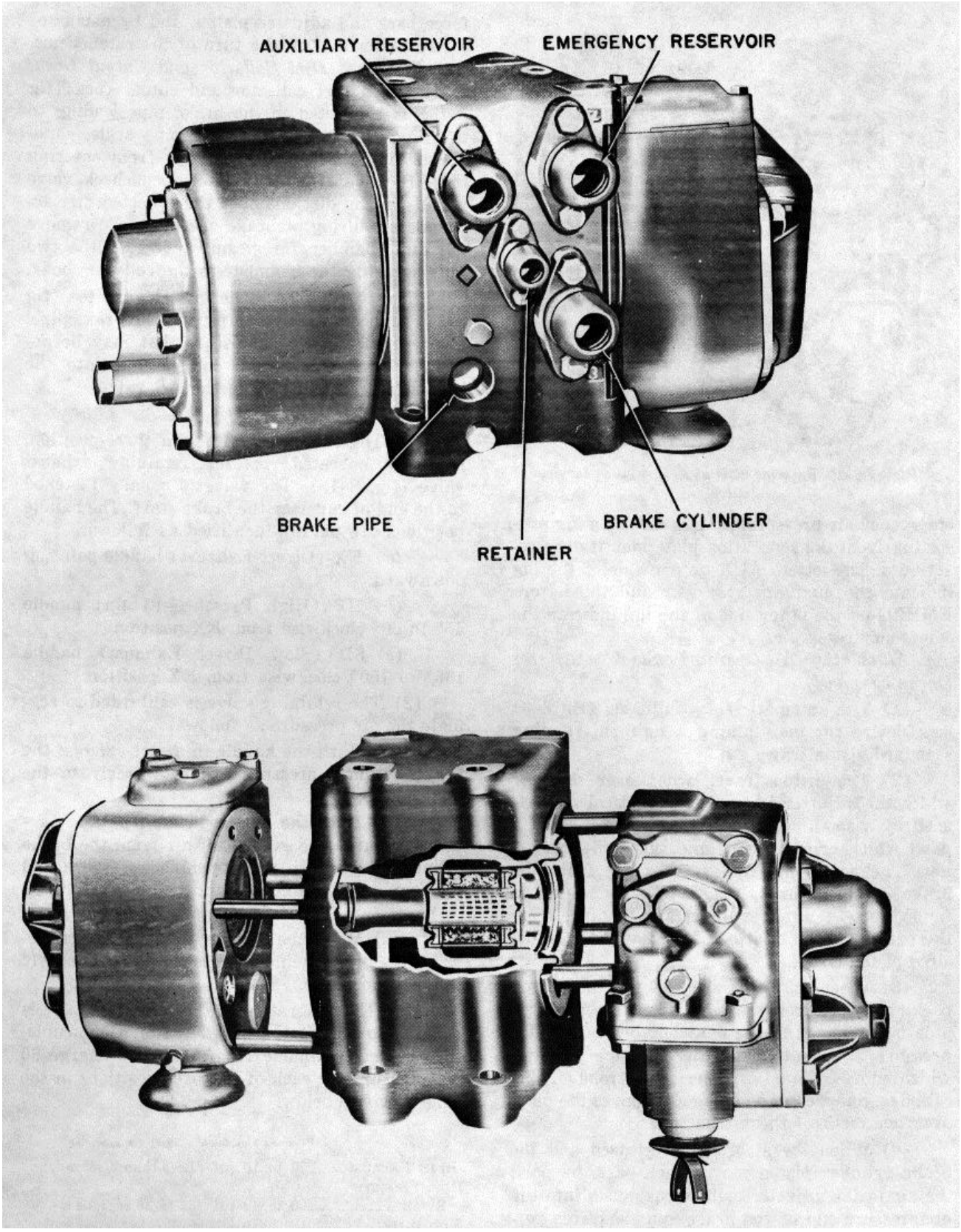


Figure 8-9. AB valve showing the operating portions with pipe bracket section cut away to show strainer.

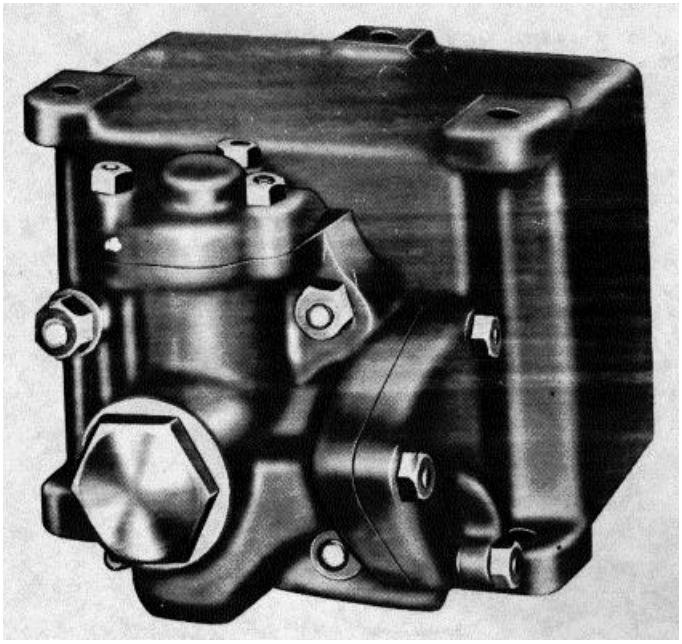


Figure 8-10. Exterior view of A-2-A quick-service value.

emergency air pressure. Letters cast on a lug projecting from the separation plate identify the reservoirs. The letters AUX on one side of the lug indicate the auxiliary reservoir and the letters EMERG on the other side of the lug indicate the emergency reservoir.

f. Automatic Air-Operated Slack Adjuster (when equipped)

(1) The automatic slack adjuster (fig 8-3) is a device for maintaining a uniform running standard piston travel.

(2) The piston travel, when over that for which the adjuster is set, is automatically shortened by a small cylinder having a piston with a pawl which engages with and turns the ratchet nut The adjuster cylinder takes air from the brake cylinder through a small pipe which is tapped into the brake cylinder at a distance from the pressure head approximately equal to the desired piston travel.

(3) When piston travel allows the piston packing cup to pass the port where the adjuster pipe is connected to the cylinder, brake cylinder pressure is admitted to the adjuster cylinder which moves the piston the full stroke of the cylinder, compresses a spring and moves the pawl over two teeth of the ratchet nut.

(4) When the airbrake is released and the brake cylinder piston moves back past the port, the air in the adjuster cylinder exhausts into the nonpressure end of the brake cylinder. This permits the piston spring in the adjuster cylinder to force back the adjuster piston, and by means of the pawl makes 1/8 of a turn of the ratchet nut.

g. Combined Dirt Collector and Cutout Cock. A combined dirt collector and cutout cock (fig 8-13) is connected in the brake pipe leading to the pipe bracket. It prevents pipe scale, sand, cinder, and other foreign matter from entering the AB valve. The umbrella-shaped check valve retains in the dirt chamber the collected dirt accumulated during airbrake operation. To remove the dirt chamber for cleaning, remove the two nuts securing the chamber to the collector body.

h. Branch Pipe Tee. The branch pipe tee (fig 8-14) connects the branch pipe to the brake pipe. It prevents excessive moisture that may be deposited in brake pipe from passing into the branch pipe and thence to the AB valve.

i. Retaining Valve.

(1) The retaining valve is a three-position, manually operated, pressure-retaining exhaust valve (fig. 8-15). The valve is usually fastened to the end of car near the brake staff The handle positions are plainly identified as follows:

(a) EX (Direct Exhaust) handle pointing downward.

(b) HP (High Pressure Retain) handle 45° to 60° clockwise from EX position.

(c) SD (Slow Direct Exhaust) handle 135° to 1500 clockwise from EX position.

(2) The retaining valve is calibrated to regulate the air pressure as follows:

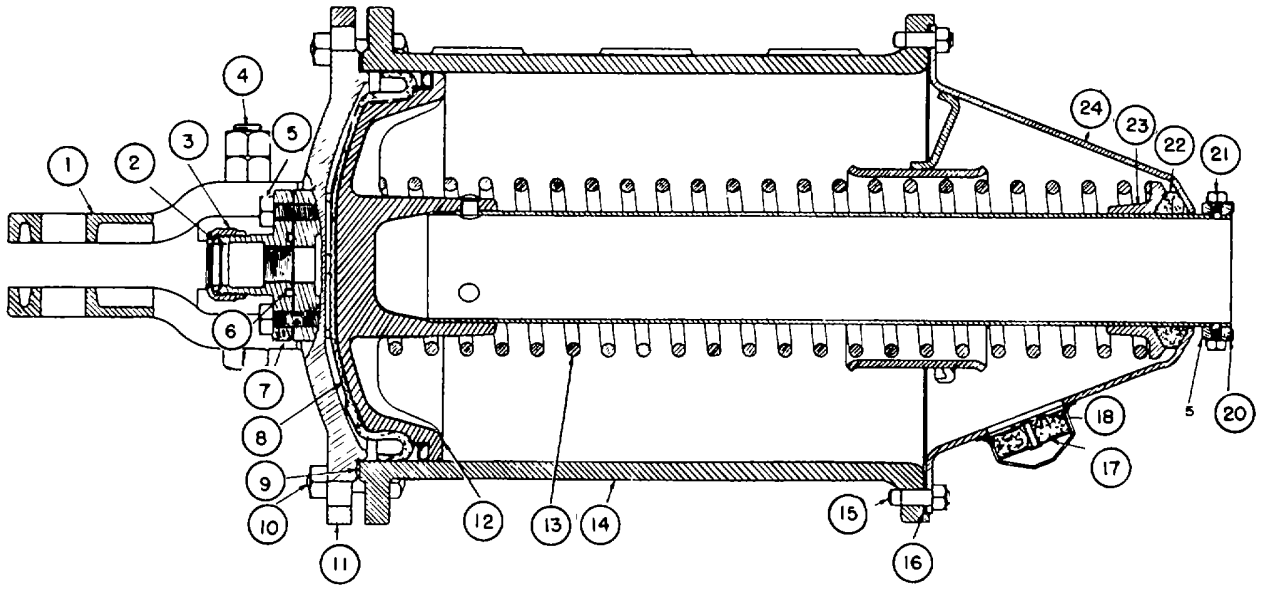
(a) With the handle in *direct exhaust* the brake cylinder pressure exhausts freely to the atmosphere.

(b) With the handle in *high pressure retain* it retards the exhaust of air from the brake cylinder down to a predetermined pressure and then retains that amount (approximately 16 to 22 psi).

(c) With the handle in *slow direct exhaust* the brake cylinder pressure exhausts slowly to the atmosphere.

(3) The calibration of the retaining valve is such as to permit the blowdown of a 435-cubic-inch reservoir volume from an initial charge 80 psi pressure for each of its three positions in the time specified below:

Position	***Pressure blowdown***	***Time (in seconds)***
Direct Exhaust	70 to 10 psi	Less than 3 seconds
High Pressure Retain	60 to 40 psi	33 to 43 seconds
Slow Direct Exhaust	60 to 40 psi	17 to 22 seconds



1 Lever bracket
2 Fitting anchor ring
3 Fitting clamping nut
4 Lever bracket bolt and two nuts
5 Fitting cap screw
6 Fitting gasket
7 Straight fitting body
8 Piston packing cup
9 Pressure head gasket
10 Pressure head bolt and nut
11 Lever bracket pressure head
12 Piston and hollow rod
13 Release spring
14 Cylinder body
15 Nonpressure head bolt and nut
16 Nonpressure head gasket
17 Strainer
18 Strainer retaining ring
19 Hollow rod collar
20 Special lock washer
21 Rod collar set screw
22 Hollow rod packing seal
23 Spring seat
24 Nonpressure head

Figure 8-11. Assembly view of the AB-A brake cylinder with lever brackets.

Note. Prior to 1967, some care were equipped with a two-position retaining valve to control brake cylinder pressure. With the handle In *down* position, the brake cylinder air exhausts freely to the atmosphere. With the handle in up position, it retards the exhaust of air from the brake cylinder down to a predetermined pressure and then retains that amount.

j. Angle Cocks. Angle cocks with hose connections and couplings are connected on the ends of the brake. They provide a flexible connection between the brake pipes on adjoining cars.

8-13. Cleaning and Testing AB Brakes on Repair Track

a. Requirements. The complete brake equipment must be cleaned, oiled, tested, and stenciled (COT&S) as follows:

(1) After expiration of 48 months as indicated by the stencil marking on car; and may be given COT&S attention after expiration of 45 months when the car is on the repair track regardless of whether or not it needs other repairs.

(2) When airbrakes are inoperative due to failure to pass the Single Car Test Device Code of Tests, unless the inoperative condition is due to renewal of pipes and fittings (including flange and compression type) duplex release valve part, vent protector, brake reservoir, combined dirt collector and cutout cock, branch pipe tee, retaining valve or parts of these items.

(3) When stenciled markings as required are missing, incorrect, or indistinct.

b. Cleaning

(1) To secure the required external clearances and reduce the cleaning time to a minimum, the following tools and equipment are required by the brake cleaning personnel for performing their respective functions:

(a) An open end S wrench with 3/4-inch and 13/16-inch openings, for dirt collector, branch pipe tee, and cutout cock.

(b) Combination socket wrench set for AB valve portions, flange fittings, and brake cylinder nonpressure head. The set consists of one ratchet-type handle, two extensions, one universal joint, and five sockets in sizes 9/16- inch, 5/8-inch, 3/4-inch, 13/1.6-inch, and 1 inch. The 13/16-inch socket is required only for the AB empty and load changeover valve.

(c) Strainer nut wrench for brake pipe strainer nuts, used with handle and extensions listed in *(b)* above.

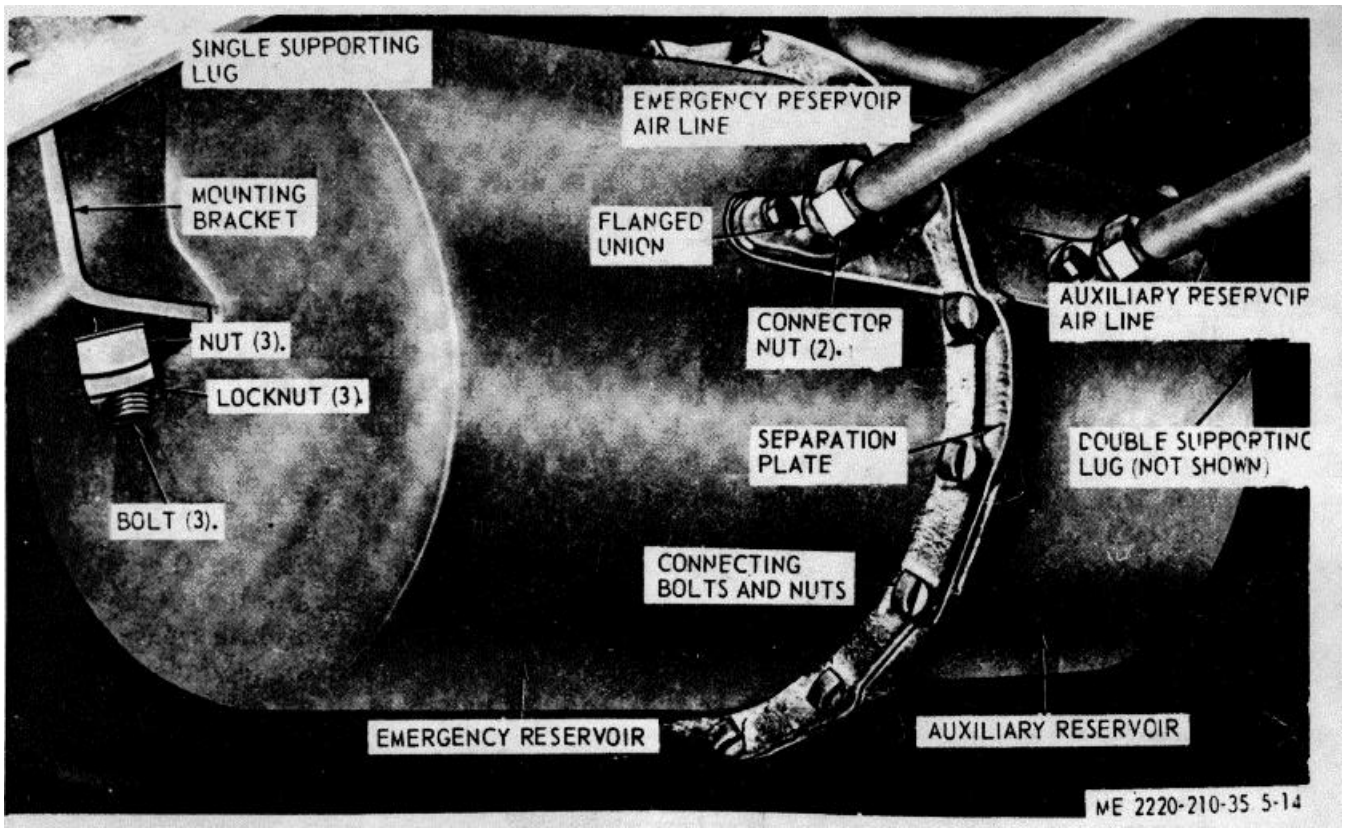


Figure 8-12. Combined auxiliary and emergency reservoir.

(d) Blowing nozzle valve with suitable 1/4-inch pipe nipple nozzle for blower hose.

(e) Shipping covers and vent protector plug as per brake manufacturer's standard for protecting AB valve portions in transit.

(f) Suitable covers or containers to protect the AB brake cylinder piston, hollow rod and nonpressure head assemblies from dirt or damage should be provided when transporting assemblies to and from the car.

(g) A grease can arranged so that both the grease and brush can be protected against dirt.

(2) Record the car number, owner, and last cleaning date. All old cleaning marks must be scraped off and painted over with quick-drying black paint.

(3) Close the branch pipe cock and drain the air out of the auxiliary reservoir, emergency reservoir, and brake cylinder. Remove the cup from the dirt collector and leave it off until cleaned valve portions are applied. Disconnect the release valve lever, leaving it attached to the release rods.

(4) Blow any dirt or water out of the yard air line and supply hose connection to car. If the brake tests are to be made by the men who clean the brake, couple the single car tester to the yard air line and the car brake pipe at the B-end of the car. Otherwise, couple the yard air supply directly to the car brake pipe. Charge the brake pipe, and leave the yard air supply connected to it. Blow out the brake pipe by opening the angle cock at the A end of car, and then apply a dummy coupling or the blower hose to the A end of the car and leave both angle cocks open. Open the branch pipe cock to blow dirt from the branch pipe, then close it.

(5) Scrape, wipe, and blow off all dirt adjacent to the gaskets between -the pipe bracket and the valve portions, then using the blower hose, blow off all loose dirt on the AB valve portions, pipe bracket, hopper slopes, car underframes, etc., that may otherwise get into the AB valve portions or pipe bracket when the portions are being removed and clean portions applied.

Note. The operating portions of the AB control valve or parts thereof must never be dismantled or have any parts removed or replaced on the car. All cleaning and relubrication of the valve portions must be accomplished by competent airbrake mechanics in a well- lighted location.

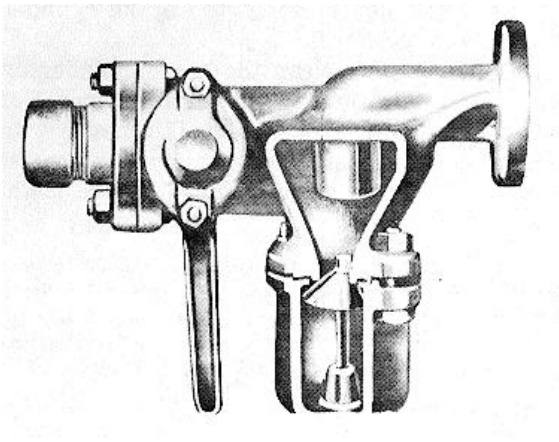


Figure 8-13. Combined dirt collector and cutout cock.

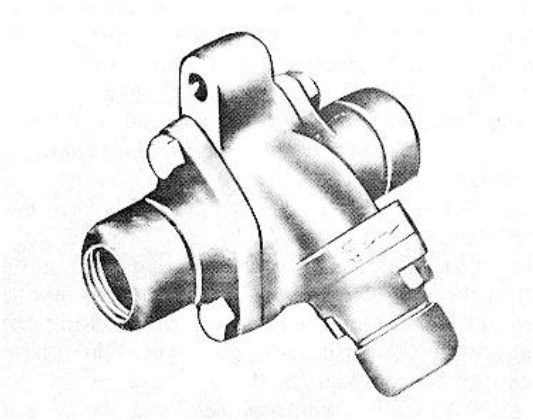


Figure 8-14. Branch pipe tee for AB brake.

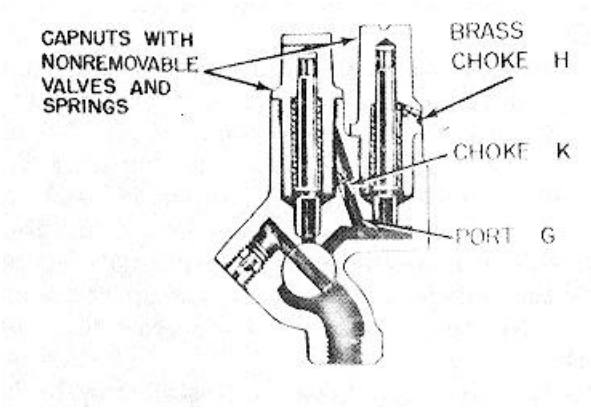


Figure 8-15. Sectional view of standard retaining valve.

c. Remove AB Valve Service Portion

(1) Disconnect the brake cylinder release rod. Remove the three nuts from mounting studs and slide the valve portion off the studs.

(2) Remove the brake pipe strainer and place it in the shipping cover. Immediately apply the cover to the service portion and tighten the holding nuts. The shipping cover must be applied to prevent entrance of dirt, water, or damage to internal parts when transporting the valve to the airbrake shop for reconditioning (para 8-15).

d. Remove AB Valve Emergency Portion

(1) Remove vent protector and plug the opening with a vent protector plug.

(2) Remove the three nuts from the mounting studs and slide the valve portion off the studs.

(3) Move the piston into release position and immediately apply the shipping cover and tighten the holding nuts. The cover must be applied to prevent entrance of dirt, water, or damage to internal parts when transporting the valve portion to the airbrake shop for reconditioning (para 8-15).

e. Remove Retaining Valve

(1) Unscrew the exhaust pipe from the elbow and uncouple inlet air line at the union.

(2) Remove the nuts and bolts that secure the valve to car end and remove valve and strainer.

(3) Place the strainer in the spare shipping cover, then apply the shipping cover and tighten the holding bolts. Transport the valve to the airbrake shop for reconditioning (para 8-15).

f. Clean Dirt Collector. Remove nuts and bolts that secure dirt chamber to collector body and remove chamber from collector body. Separate gasket and check valve from the collector. Thoroughly clean chamber and check valve of all dirt and other foreign matter. *Do not replace chamber and check valve until after pipe bracket and associate parts have been cleaned (G, below)*. When replacing check valve and chamber, use a new gasket between chamber and body.

g. Clean Pipe Bracket and Associate Parts

(1) Using scrapers of suitable form, loosen any dirt in the brake pipe passages, strainer chamber, and other connecting passages of the pipe bracket.

(2) Use a blower hose with a suitable nozzle and blow any loose dirt and scale from pipe bracket and associate parts. Blow dirt from the face of the bracket, strainer chamber, and branch pipe passage toward the open dirt collector.

h. Install Reconditioned Service Portion

(1) Apply a new throw-away type or a cleaned felt or hair type strainer to the cavity in the pipe bracket. Use a wood mandrel to guide

the strainer into proper position. Make sure of its inner engagement with sealing bead (if inserted properly, all nut threads will be visible). Apply its holding nut and tighten it firmly.

(2) With the service portion gasket in place on the pipe bracket and fully seated in its locking projection, remove the shipping cover from the clean service portion. With the piston in release position, immediately mount the portion, sliding it slowly and carefully on the studs against the pipe bracket. Coat the stud threads with graphite grease and tighten the holding nuts evenly and then firmly.

(3) Connect the brake cylinder release rod to the release valve handle.

i. Install Reconditioned Emergency Portion

(1) With the emergency portion gasket in place on the pipe bracket and fully seated in its locking projection, remove the shipping cover from the clean emergency portion Examine the emergency piston to insure it is in release position. Damage to the piston and bush will result if the piston is out of the bush while the portion is mounted on the pipe bracket.

(2) Mount the portion, sliding it slowly and carefully on the studs against the pipe bracket. Coat the stud threads with graphite grease and tighten the holding nuts evenly and then firmly.

(3) Remove the vent protector plug and apply and securely tighten a serviceable vent protector to the clean emergency portion.

j. Install Reconditioned Retaining Valve. Install retaining valve in reverse of removal (e, above). Make sure the valve is securely fastened to the car in a vertical position and that the handle moves freely (para 8-24b).

k. Clean and Lubricate Frame-Mounted Brake Cylinders

(1) Disconnect brake lever and remove brake cylinder push rod.

(2) To avoid personal injury, examine the hollow rod collar on end of piston to determine if it will hold securely.

(3) Remove the pressure head bolts and then remove the piston, release spring and nonpressure head complete.

(4) Apply a shipping cap to the nonpressure head. This will protect the piston packing cup, lubricator swab assembly, and other parts against damage and contact with dirt when transporting the assembly to the airbrake shop for reconditioning (para 8-18).

(5) If the nonpressure head gasket is in suitable condition to provide a tight seal, replacement is not required. If damaged, remove gasket, clean its seat when cleaning the brake cylinder and apply new gasket.

(6) Thoroughly clean the brake cylinder by first using a dull rounded scraper for removal of all grease and dirt. Use solvent, if necessary, to soften gummy deposits and remove rust spots, then wipe dry and clean with a lint-free cloth.
Do not use cotton waste.

Note. After cylinder is cleaned, it should be covered to protect it from dust and dirt unless the piston and nonpressure head assembly is to be immediately installed. The lubricant must be applied to the cylinder just before the cleaned and lubricated piston is applied.

(7) Using a suitable brush, coat the cylinder wall thoroughly with a thin layer of brake cylinder lubricant. Place the nonpressure head gasket in correct position in the recess on the cylinder flange. Remove the shipping cover from the piston assembly. Coat the cylinder wall bearing surface of the packing cup and fill the grease groove of the swab retainer with brake cylinder lubricant. Insert the piston assembly in the brake cylinder as follows:

(a) Stand the piston assembly on end with the nonpressure end down.

(b) With the piston in this position, enter it into the cylinder. Slowly raise the nonpressure head until the upper portion of the packing cup engages in the cylinder wall. Shove the piston back into the cylinder.

(c) Apply nonpressure head bolts and tighten evenly and then securely.

(d) Apply push rod and connect it to brake lever with brake lever pin and secure with cotter key.

Clean and Lubricate Truck-Mounted Brake Cylinders

(1) Remove cotter pin and anchor pin from the piston rod and release the rod from the yoke.

(2) Remove capscrews that secure the air line adapters to the cylinder and separate the adapters from the cylinder. Remove the gaskets.

(3) Remove locknuts, nuts, and bolts that secure the brake cylinder to the truck bolster. Remove the cylinder assembly and transport the assembly to the airbrake shop for reconditioning (para 8-18).

(4) Using new gaskets, install the brake cylinder in reverse of removal.

m. Inspect Brake Rigging

(1) Check all brake levers and rods to insure that they conform to the standard dimensions shown on the metal badge plate attached to car. Wrong brake levers or brake rods shall be replaced with standard to car except where brake

levers on car are of same ratio as dimensions on badge plate.

(2) Inspect bottom rod and brake beam safety supports. Repair or renew as necessary.

(a). Brake beams, brake hangers, hanger pins, and brackets must be checked in accordance with the condemning limits shown below and renewed or repaired as necessary: (a) Brake beam hangers of round or other section, irrespective of original diameter or thickness, if vertical thickness of top or bottom portion is worn or reduced to 3/4 inch or less when measured vertically or through the corners measured on the radius.

(b) Brake beam hanger pins or bolts, originally 1 inch in diameter, if worn to 7/8 inch or less.

(c) Brake beam hanger pins, bolts or brake connection pins, originally in excess of 1 inch in diameter, if worn to 1 inch or less at any point.

(d) Brake beams should be renewed when tension rods are cut or worn 5/16 inch or more below original diameter or when brake heads are worn so that the vertical thickness of the top portion of top eye is worn 7/8 inch or less; center or upper hanger openings are worn so that the opening measured vertically at hanger bearing is 1 1/2 inches or more; the distance between upper and lower brakeshoe lugs exceeds 2 1/4 inches measured at face of head; one or more toes are broken or worn off to such extent that no portion will contact the back of brakeshoe when brakes are applied; brake hanger bracket cast integral with truck side bolster, having pin hole worn oblong to a depth of 1/2 of its original diameter, or worn oblong not more than 40 percent, shall be restored to original diameter by bushing or by fusion welding process. If the hanger bracket is not cast integral with truck side or bolster, it shall be repaired or renewed when pin hole is worn to the extent specified above.

Note. The wear limits prescribed above are primarily intended to apply to inspection made of cars in shops or on the repair track, as such parts cannot be measured or gaged with any degree of accuracy without disassembly. The determination of condemning limits of these parts in tralnyards must therefore be left to the exercise of good judgment by the trainyard inspector,

(3) Inspect brakeshoes for broken or missing keys and worn or damaged shoes. Brakeshoes shall be renewed with any of the following defects:

(a) AAR standard type with 1/2 inch or less wear metal. Composition type with 3/8 inch or less thickness, including lining and backing plate.

(b) Broken or part missing. Wear metal broken through and sliding on reinforced back.

n. Clean, Test and Adjust Air-Operated Auto-mattec Slac Adjusters

(1) Remove the capscrews that secure the air line adapter to the adjuster cylinder and separate from the cylinder and remove gasket.

(2) Refer to figure 8-3(2) and remove the three casing nuts and lockwashers that secure the engine portion to the adjuster body. Turn the engine portion off the adjuster screw and transport it to the airbrake shop for reconditioning.

(3) Remove the crosshead and adjuster screw from adjuster body. Clean the screw threads thoroughly with a wire brush. *Do not lubricate*. The adjuster screw nut should turn freely on the screw. If the threads of the screw or nut are excessively worn, replace with serviceable parts. Blow out the slack adjuster air line to insure that the brake cylinder port is open.

(4) Assemble the adjuster screw, crosshead, and reconditioned engine portion in reverse of removal. Use new gaskets between engine portion and adjuster body and the air line adapter and the adjuster cylinder.

(5) Adjust brake cylinder piston travel as follows:

(a) Apply the brakes with full service application. With brake thus applied, measure and record piston travel. Check all levers and rods for proper clearance. Inspect brake cylinder and slack adjuster connections for leakage.

(b) Release brakes and see if slack adjuster has operated. If the adjuster has not operated and the shoes clear the wheels by 3/8 inch, no adjustment is necessary. If shoes exceed 3/8 inch, adjust brake rigging manually. If the slack adjuster operates and piston travel is excessive, adjust brake rigging manually.

(c) On swivel trucks where the brakes on more than one truck are operated by the same cylinder, adjust standing piston travel to 7 1/2 inches. Where the cylinder operates the brakes on one truck only and on units equipped with truckmounted brake cylinders, adjust the piston travel for that type of brake cylinder.

o. Inspect Airbrake Hoses. Carefully inspect airbrake hoses and renew if found defective because of the following wear limits:

(1) Burst hoses.

(2) Leakage discernible without soapsuds test.

(3) Abrasion through the outer covering which indicates damage to, or deterioration of, the first layer of duck (fig. 8-16).

(4) Longitudinal or spiral cracks which show damage to, or deterioration of, the first layer of duck (fig 8-17).

(5) Soft spots which clearly indicate that the fabric has broken down (fig 8-18).

(6) Loose or defective fittings on either end or on both ends of the hose.

(7) End of the tube 3/8 inch or more from the shoulder of either the nipple or the coupling.

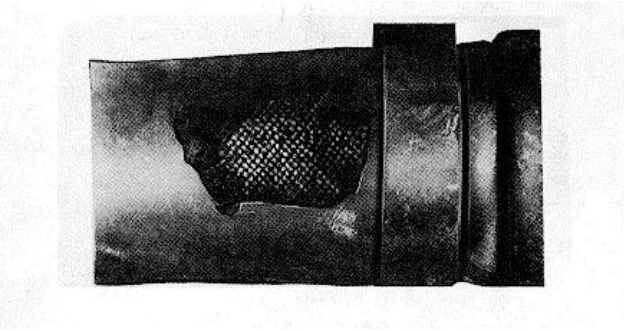


Figure 8-16. Hose with a hole in outer cover. Fabric in good condition.

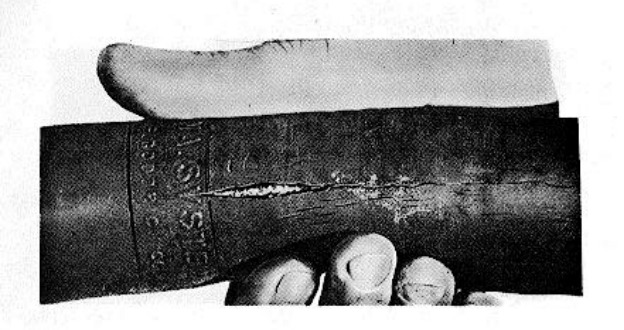


Figure 8-17. Hose with a bad longitudinal crack in outer casing.

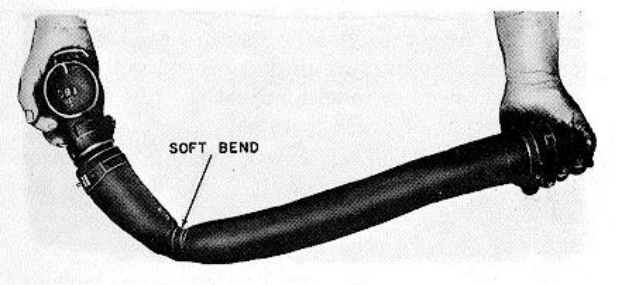


Figure 8-18. Hose with a "soft" bend.

(8) Porous hose, as determined by soapsuds test.

(9) Spliced hose.

(10) Missing hose.

(11) Over 8 years old (determined by date on hose), date obliterated at time of cleaning, oiling, testing, and stenciling, or periodic attention (indate testing and stenciling) of airbrakes.

p. Perform Code of Tests. After all work is completed, blow out supply line to which testing device is to be attached and perform code or tests in accordance with TM 55-2006.

q. Apply Stenciling

(1) Scrape off old stencil and paint over with quick-drying paint.

(2) Apply stenciling showing month, day, and year, railroad or private line, line reporting marks, and initial of shop or station (fig 819).

(3) If location of lettering does not present a clear view from outside of car, stenciling shall be placed on side sill near release valve handle. *Do not stencil both reservoir and side; only one stencil is permitted.* On tank cars, where location of reservoir is such that stenciling would be obliterated due to spillage, stenciling may be located on reservoir side of center sill between bolsters and close to B end bolster as possible. On hopper cars where construction of car will permit, stenciling may be located on sub side sill near release rods. The application of duplicate markings is prohibited.

Note. Stencil markings must not be changed until all work has been completed.

8-14. Cleaning and Testing AB-1-B Brakes on Repair Track

Cleaning, oiling, testing, and stenciling of AB1-B brakes is the same as that for AB brakes (para 8-13), with the following additional instructions:

a. Remove Filling Piece with Selector Valve

(1) Remove emergency portion (para 8-13d).

(2) Disconnect air piping from filling piece.

(3) Slide filling piece with selector valve off mounting studs. Immediately apply shipping cover to selector valve and tighten holding nuts. The shipping cover must be applied to prevent entrance of dirt, water, or damage to internal parts when transporting the valve to the airbrake shop for reconditioning (para 8-16).

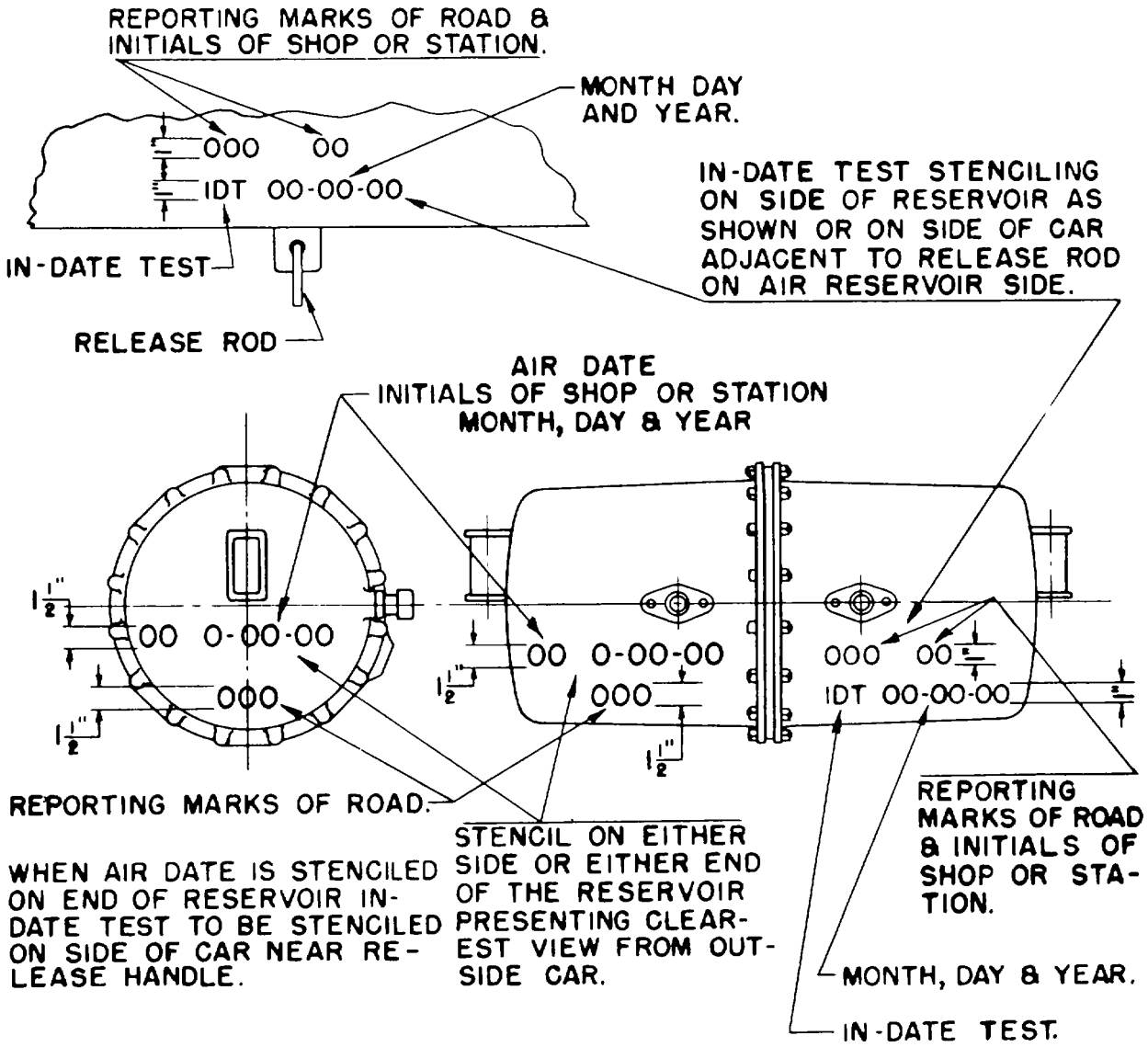

REPORTING MARKS OF ROAD & INITIALS OF SHOP OR STATION.
MONTH DAY AND YEAR.
000 00
IDT 00-00-00
IN-DATE TEST
RELEASE ROD
IN-DATE TEST STENCILING ON SIDE OF RESERVOIR AS SHOWN OR ON SIDE OF CAR ADJACENT TO RELEASE ROD ON AIR RESERVOIR SIDE.
AIR DATE
INITIALS OF SHOP OR STATION
MONTH, DAY & YEAR
00 0-00-00
000
00 0-00-00
000
000 00
IDT 00-00-00
REPORTING MARKS OF ROAD.
WHEN AIR DATE IS STENCILED ON END OF RESERVOIR IN-DATE TEST TO BE STENCILED ON SIDE OF CAR NEAR RELEASE HANDLE.
STENCIL ON EITHER SIDE OR EITHER END OF THE RESERVOIR PRESENTING CLEAREST VIEW FROM OUTSIDE CAR.
REPORTING MARKS OF ROAD & INITIALS OF SHOP OR STATION.
MONTH, DAY & YEAR.
IN-DATE TEST.

Figure 8-19. Stenciling for cleaning, oiling, testing, and stenciling in-date testing of airbrakes.

b. Remove A-2-A Quick-Service Valve

(1) Clean exterior of valve thoroughly of all dirt and other foreign matter.

(2) Remove nuts from mounting studs. Carefully slide valve off mounting studs and apply shipping cover.

(3) Transport valve to the airbrake shop for reconditioning (para 8-17).

c. Install Reconditioned Filling Piece with Selector Valve

(1) With the filling piece gasket in place on the pipe bracket and fully seated in its locking projection, remove shipping cover and slide filling piece on mounting studs. Make certain it fits snugly against pipe bracket.

(2) Install emergency portion as specified in paragraph 8-13i.

d. Install Reconditioned A-2-A Quick Service Valve

(1) With the valve gasket in place on the pipe bracket and fully seated in its locking position, remove shipping cover and slide valve on mounting studs.

(2) Coat threads of studs with graphite grease and tighten holding nuts evenly and then firmly.

8-15. Shop Maintenance of AB Control Valve

a. General

(1) The purpose of these instructions is to avoid unnecessary expense due to careless handling of the parts. It is possible to dismantle or assemble all parts of the valve readily. If excessive force is required, make an investigation immediately as to the cause of the difficulty.

(2) When dismantling the operating portions, exercise care to avoid distortion of belts, studs, nuts, and like items by using tools especially adapted for this type of work. Similar care must be taken to avoid mutilation or damage when dismantling the valves with respect to pistons, springs, gaskets, slide valves, graduating valves, and like items.

(3) Completely dismantle the operating portions and lay out the parts as illustrated in figures 8-20 through 8-25. Wash all metal parts in approved solvent that will dissolve oil and grease without abrasion.

(4) Dip all gaskets and rubber seated valves in approved solvent to assist in the removal of greasy dirt and immediately wipe dry after cleaning. Do not soak the parts in the cleaning fluid.

(5) Replace all gaskets which have broken or flattened beads or any that reveal cracks or cuts on diaphragms or sealing surfaces. Remove and replace all "0" rings.

(6) Brush serviceable gaskets with a soft bristle brush (such as a shoe brush) to remove any remaining dirt and to give them a polish.

(7) Check all piston bushings for shoulders, grooving, cracks, pitting, hollow ring bearing surfaces, and for taper and out-of-round with a dial indicator gage. If necessary, true up the bushings on a precision grinder, boring machine, or hand grinder before being gaged for ring size. After bushings are reconditioned, wipe with an oily cloth and then wipe clean with a clean, lint-free cloth. Finally, clean with an approved solvent to remove all traces of powdered bushing material before reassembling the piston.

(8) When necessary to remove or replace the piston ring, use suitable tools to avoid damage to the groove.

(9) Splined socket choke plugs are now supplied in place of the screwdriver slotted type. The splined socket type can be readily removed or applied without damage to the choke plug or to the thread in the tapped hole.

(10) The size of chokes is important. The choke fittings must be removed, cleaned, and inspected, to insure that they are not restricted. Do not use metallic tools for cleaning chokes, as their size and shape must not be changed. Check passages for cleanliness and blow out if necessary. Replace chokes in the same location from which removed. The choke fittings for each portion are described under the heading for that particular portion.

(11) Replace all springs which show rust pits or distortion, or which have a permanent set. A list of springs and a table of identification are presented under the heading of that particular portion.

(12) When reassembling valve portions, tighten cap screws and nuts sufficiently to prevent gasket leakage but not excessively to cause distortion of covers and gaskets.

b. Service Portion

(1) Choke fittings. The service portion contains five choke fittings. Three of the five choke fittings are shown in figure 8-20. They govern the flow of air through the ports in which they are located as follows:

(a) The choke located in the body under the cover controls the flow of air from the quickservice portion to the atmosphere.

(b) The choke located under the limiting valve cover controls the flow of air in the quickservice passage between the slide valve and the limiting valve.

(c) The choke located in the cover controls the flow of air in the passage between the release insuring valve and the slide valve exhaust in service lap position.

(d) The correct orifice size of each of the above three chokes is 1/32-inch drill.

(e) Two chokes (not illustrated) which are located in the service portion body, control the charging of the auxiliary reservoir. The correct orifice size is No. 57 drill (.043 inch).

(2) Springs. The service portion has a total of ten springs (nine coil and one leaf) which are identified as follows:

(a) Release insuring valve spring ((8), fig 8-21) holds the valve on its seat until brake valve pressure rises 1 1/2 pounds above auxiliary reservoir pressure.

(b) Diaphragm spring ((5), fig. 8-22) acts on the diaphragm of the quick-service limiting valve to hold the valve open until the force of the spring is balanced by a brake cylinder pressure of 10 pounds.

(c) Piston spring ((12), fig 8-22) mounted in the stem resists movement of the piston and graduating valve after the feed grooves or charging ports are closed and just previous to opening of the preliminary quick-service port.

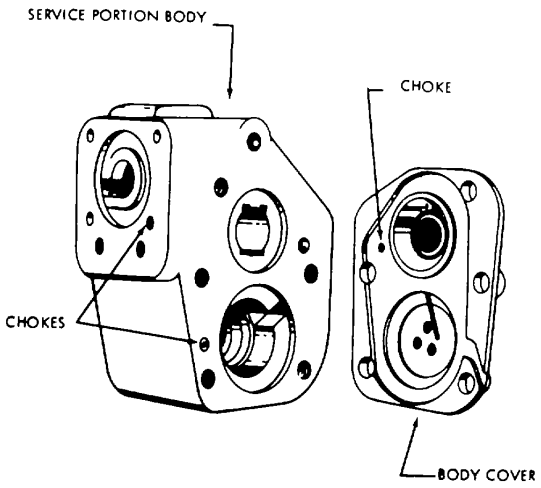


Figure 8-20. Location of chokes in service portion body and cover.

(d) Return spring ((14), fig 8-22) returns the piston and slide valve from retarded recharge to normal recharge position.

(e) Slide valve spring ((15, fig 8-22) holds the service slide valve to its seat.

(f) Graduating valve spring ((17), fig 8-22) holds the graduating valve to its seat.

(g) Check valve spring ((6), fig 8-23) holds the limiting valve check and backflow check to their seats.

(h) Check valve springs ((8), fig 8-23) hold the auxiliary and emergency reservoir release check valves to their seats when the release valve plunger is down.

(i) Duplex release valve plunger spring ((17), fig 8-23) returns the plunger to normal position when the operating rod is released, so that reservoir release check valves can return to their seats.

(j) Spring identification. The following tabulation gives the Westinghouse Airbrake data necessary to identify each of the springs described.

Table 8-1. Spring Identification AB Service Portion

Reference No.	Part No.	Approximate O D.	Approximate dia wire	Approximate free height	Approximate No. turns	Material
8, fig 8-21	A96026	31/64"	.047"	1 9/32"	10	Steel
5, fig 822	A95023	1 9/64"	.125"	3"	10 1/2	Steel
12, fig 8-22	A501006	13/16"	.062"	2 13/32"	11	Steel
14, fig 8-22	A95026	1 27/32"	.156"	3 45/64"	8 Steel	
17, fig 8-22	A93940	5/32"	.020"	21/32"	12	PH. Bronze
6, fig 8-23	A94852	15/32"	.035"	15/16"	7	PH. Bronze
8, fig 8-23	A93972	9/16"	.057"	1 15/32"	8	Steel
17, fig 8-23	A95025	59/64"	.098"	2 15/16"	10	Steel

(3) *Inspection and lubrication of choke fittings*. Check all choke sizes ((1) above). Coat threads of choke fitting's lightly with a compound consisting of one part graphite and two parts oil (SAE-20) by weight. *Make sure the chokes are replaced in the same location from which removed.*

(4) *Inspection and lubrication of slide valve*

(a) Remove slide valve ((16), fig 8-22) from service piston (22). Check retaining pin holes in slide valve and slide valve pin tube for excessive wear.

(b) Remove shoulders or roughness on slide valve by facing with No. FF-280 Carborundum cloth placed on a lapping plate. Then finish slide valve on lapping plate, using flour of emery as an abrasive.

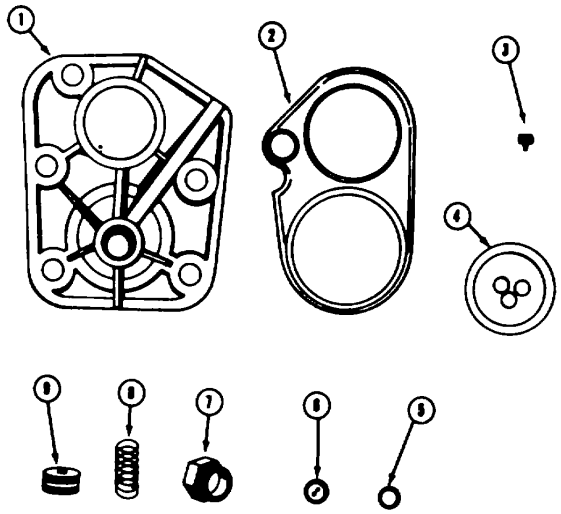
(c) Recondition slide valve seat in body with lapping stick faced with No. FF-280 Carborundum cloth placed on the underside of the lapping stick tool. Remove burrs from all ports in the slide valve seat. *Do not enlarge the ports when removing burrs.*

(d) Clean all parts with an organic solvent type of cleaner to remove all dirt, oil, gum, or grease. Do not use an alkaline cleaning solution. Lubricate the entire surface with one drop of lubricating oil (SAE-20).

(5) *Inspection and lubrication of graduating valve*

(a) Check the lengthwise clearance of the graduating valve (20, fi 8-22), in the piston assembly. The lengthwise clearance must be not less than, 0.004 inch.

(b) Check graduating valve seat in the body and lap seat using H-40 fine Carborundum compound or an approved metal polish.



1 Service portion cover
2 Cover gasket
3 ⅛-inch choke plug ('₂₂" drill)
4 Diaphragm follower
5 Release insuring valve adjusting nut
6 Release insuring valve locknut
7 Release insuring valve capnut
8 Release insuring valve spring
9 Release insuring valve

Figure 8-21. Service portion cover and release insuring parts.

(c) Thoroughly clean all parts with an organic solvent type cleaner to remove all dirt, oil, gum, and grease. Do not use an alkaline cleaning solution. Lubricate the entire surface with one drop of lubricating oil (SAE-20).

(6) *Inspection and lubrication of self-oiling piston*

(a) Clean the piston ring and its groove by dipping the piston in cleaning fluid and then moving the ring around in the groove. Repeat the operation until the groove and ring are thoroughly cleaned.

Note. An early type of self-oiling piston, having two holes drilled in the piston head near the top of the piston, must not be submerged in cleaning fluid. For this type of piston, see instructions in (7) below.

(b) Where rings are stuck with dirt too tightly to be moved in the groove, soak the ring in penetrating oil and then tap the ring gently with a hardwood block to drive it flush with the top edge of the groove. Start the tapping at one side of the ring joint and progress around the piston in short steps until the ring is loosened sufficiently to be moved in the groove. If this procedure will not loosen the ring, it is evident that the groove is binding and must be reconditioned and a new ring fitted.

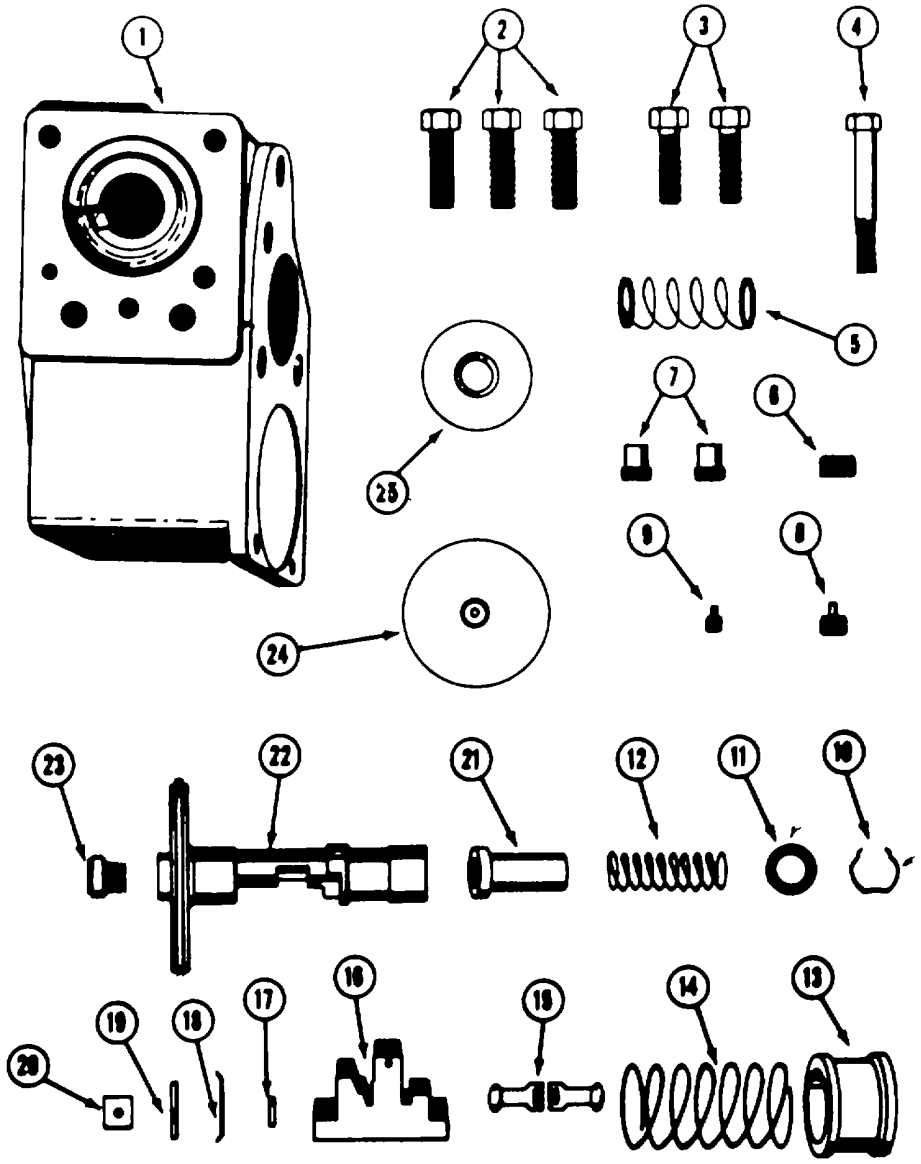
(c) When a new ring is to be fitted, place ring in the body cylinder; a snug fit should be obtained. Check alignment of piston and position outside surface of ring into ring groove. Turn the ring the full length of the circumference and note if ring is restricted from turning freely. If ring does not turn free, remove burrs or repair as required. Position ring in groove. A slight drag should be felt when, turning the ring in the groove.

Note. When fitting new lap joint rings, they must be carefully installed with the narrow bearing surface of the scarf towards the brake pipe side.

(d) If the wick which runs from the small crescent-shaped recess in the bottom of the ring groove to the oil reservoir is damaged, it must be replaced. A new wick is approximately 5 3/4 inches long. To facilitate assembly, a special wick is available having bare wire on one end for about 2 1/4 inches. If specially prepared wicks are not available, bare the wire by burning. Start the wire down through the wick hole and pull the wick through the hole until about 1/2 inch end is left in the ring groove. Bend the end of the wick across the middle or breather hole and anchor in the last hole in the recessed ,section at the bottom of the ring groove. Cut the bare wire off the wick and wind it in a counterclockwise direction around the oil reservoir. The free end of the wick must not obstruct or come in contact with the 1/32-inch-diameter breather hole located adjacent to the wick hole in the oil reservoir.

(e) When the piston ring and its groove are thoroughly clean and dry, position the end of the ring above the lubricating hole in the bottom of the ring groove. Raise the end of the ring and make sure that the lubricating wick is flat on the bottom of the recessed portion of the ring groove. The wick must not touch the ring or the mouth of the breather hole.

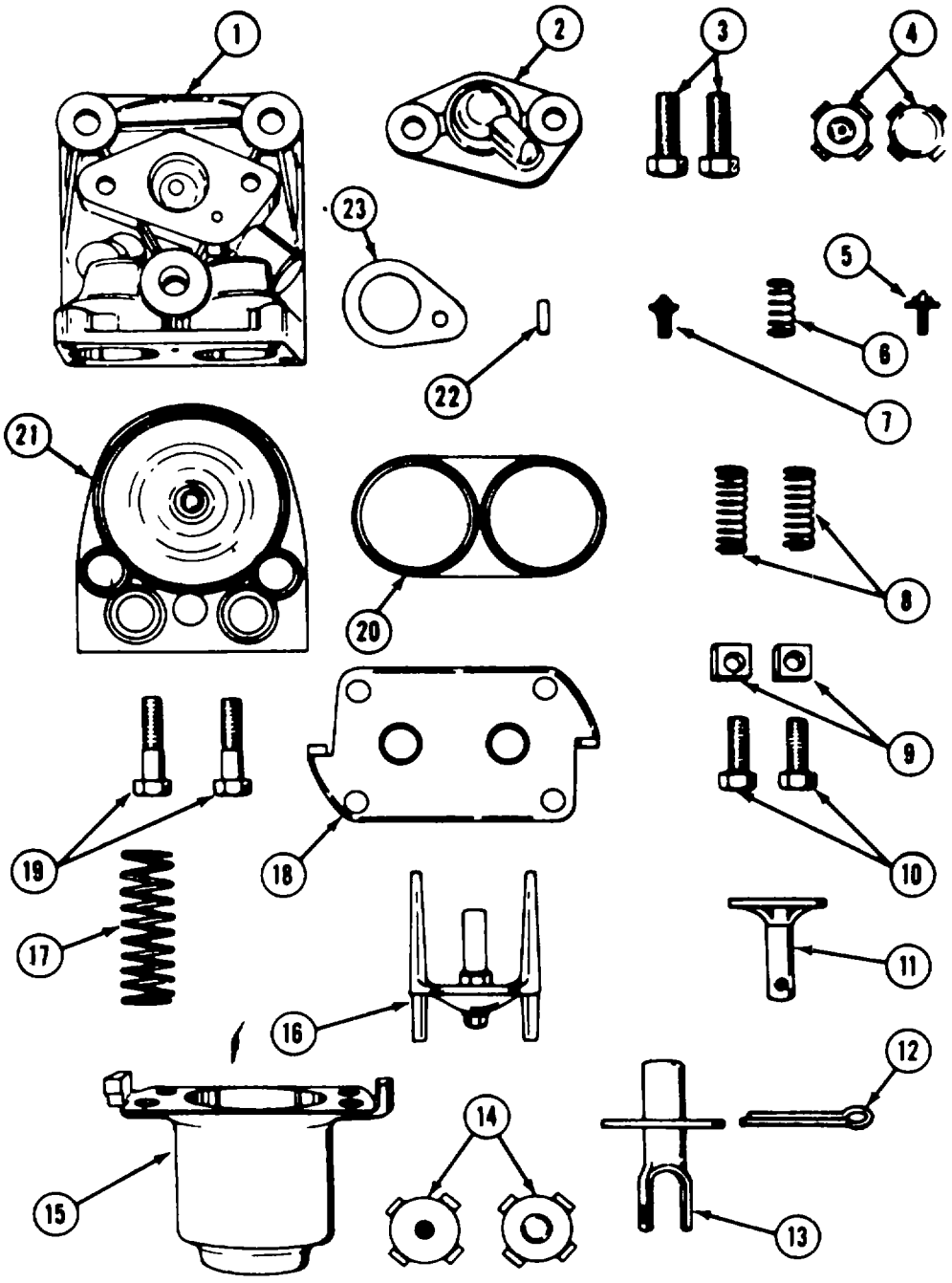
(f) Remove the oil plug which seals the oil reservoir and drain the old oil from the reservoir. If the oil plug is of the hexagon type, insert a capscrew into the outer tapped opening so it will not be distorted with the wrench when being removed. Use care to avoid twisting the piston stem. If the oil plug has been tightened excessively, tap lightly or use some other means in loosening it rather than by means of a wrench and vise, which will cause damage.



1 Body
2 Hex head capscrew (3)
3 Hex head capscrew (2)
4 Hex head capscrew
5 Diaphragm spring
6 Splined socket plug
7 ¼-inch auxiliary reservoir charging choke plug (.043" drill) (2)
8 ¼-inch choke plug (⅛" drill) limiting valve Q.S. choke
9 ⅛-inch choke plug (⅛" drill) Q.S. chamber exhaust
10 Spring seat retainer
11 Service piston spring seat
12 Piston spring
13 Return spring cage
14 Return spring
15 Slide valve spring
16 Slide valve
17 Graduating valve sp 'ng
18 Slide valve spring pin lock
19 Slide valve spring pin
20 Graduating valve
21 Piston spring guide
22 Service piston
23 Piston oil plug
24 Diaphragm stop
25 Diaphragm follower

Figure 8-22. Service portion body and parts.

(g) Place piston in a vise with copper Jaws and tighten only enough to hold the piston without damage. With the piston head in a horizontal position and the stem down, fill the reservoir with lubricating oil until the oil is level with the bottom of the threads located in the center of the piston head. Tighten the oil plug (with capscrew still in place, if used) only tight enough



1 Quick service limiting valve cover
2 Check valve case
3 Hex head capscrew (2 rqr)
4 Quick servicing limiting check valve (2 rqr)
5 Check valve spring seat
6 Check valve spring
7 Check valve spring guide
8 Check valve spring (2 rqr)
9 Square nut (2 rqr)
10 Hex head capscrew (2 rqr)
11 Release valve handle end plate
12 Cotter pin
13 Release valve handle
14 Release check valve (2 rqr)
15 Release valve body
16 Release valve plunger
17 Release valve plunger spring
18 Duplex release valve filling piece
19 Hex head capscrews (2 rqr)
20 Release valve body gasket
21 Q.S. limiting valve diaphragm
22 Check valve plunger
23 Check valve case gasket

Figure 8-23. Quick-service limiting valve and parts.

to prevent oil leakage. Make sure the oil plug makes a seal between the flanged collar and the vearing surface on the piston to prevent oil leakage out of the chamber. Remove capscrew from oil plug, if used. To tighten oil plugs of the non-hexagon type, use a torque wrench and tighten to a force of 17 foot-pounds (200 inch-pounds).

(7) *Inspection and lubrication of early type self-oiling piston*

(a) The early vintage type self-oiling piston has two holes drilled in the piston head near the top of the piston. *The piston must not be submerged in cleaning fluid*. To clean the ring and its groove, squirt the cleaning fluid around the ring and then move the ring around in its groove. Repeat the operation until the ring and groove are thoroughly clean. After cleaning, blow the excess fluid away with a jet of air.

(b) If it is necessary to remove the ring from the piston ((6) above), remove the wick in the bottom of the groove. Do not replace when a new ring is applied.

(c) Follow the same procedure for filling the oil reservoir as described in (6) above.

(8) *Inspection and lubrication of release-insuring parts. Inspect the release-insuring parts* (fig 8-21) for defects Reseat valve and seat if necessary Test spring for proper tension using a spring gage Apply new spring if required.

(9) *Inspection and lubrication of quick-service limiting valve and duplex release valve parts*

(a) Inspect the quick-service limiting check valves and release check valves and seats for pitting. Renew if found defective. Lubricate the rubber check valves by placing them in a box with dry graphite. Shake the box and remove check valves, wipe off excess graphite with a chamois.

(b) Lubricate the two short prongs of the duplex release valve plunger that fit in the bottom of the reservoir. Release valve body with brake cylinder lubricant prior to assembly to the body.

(10) *Assembly of parts to service portion body*

(a) Press the side of the piston ring opposite the scarf to the bottom of the ring groove and apply three drops of lubricating oil through the ring scarf opening. Restore the ring to normal position and carefully rotate ring in groove to distribute the oil. Position the ring scarf approximately 1 inch on either side of the piston top center.

(b) Apply a few drops of oil to piston bushing and distribute evenly over the entire surface. Evenly distribute one drop of oil on the collar at the piston spring end of the piston. Then insert the piston and slide valve in the body, ,leaving them in release position.

(c) Assemble balance in parts in reverse order of removal, using new parts as required.

(11) *Performance of code of tests*. Install reconditioned valve portion on test rack and refer to TM 55-21023 for testing instructions.

c. Emergency Portion

(1) Choke fittings. The emergency portion contains six choke fittings; figure 8-24 illustrates the location of these choke fittings. The instructions for cleaning and checking choke fittings in the service portion apply for all of these chokes except for chokes (1'), (3), and (4) which are not readily removable and should be cleaned in place. The removable chokes (2), (5), and (6) must be removed, cleaned, and replaced one at a time. Remove the filter felt in choke (5), clean, and replace or renew if damaged. If choke (5) is the earlier type which does not have a filter felt, replace with the latest design.

(a) Choke (3), which serves to protect against excessive spillover check valve leakage, is located in the bushing under the spillover ball check (11, fig 8-25). Orifice size 3/64-inch drill.

(b) Choke (4) (fig 8-24), which serves to protect against diaphragm leakage, is located an the ball check cover in the port between the chamber above the spiliover valves and the chamber above the strut diaphragm. Orifice size No. 69 drill.

(c) Choke (1), which serves to control the rate of quick-action chamber pressure reduction during an emergency application, is located in the vent piston. Orifice size No. 69 drill.

(d) Choke (6), which controls the second stage flow of air to the brake cylinder immediately after the incite valves closes during an emergency application, is located in the emergency portion body and is accessible by removing a 1/4inch pipe plug. Orifice size 3/32-inch drill.

(e) Choke (5), which controls the quickaction chamber charging rate, is located in the emergency portion body under the ball check cover. The attached filter felt prevents restriction of the choke by very fine dirt, thereby insuring the proper charging rate of the quick-action chamber. Orifice size No. 73 drill.

(f) Choke (2), which controls the third stage of brake cylinder pressure buildup during emergency application, is located under the emergency portion cover in the port which bypasses choke (6) when the timing valve opens. Orifice size 9/64-inch drill.

(2) *Springs.* The emergency portion contains a total of nine wire springs which are identified on figure 8-25 as follows:

(a) Accelerated release check valve spring 5, holds the check valve (4) to its seat.

(b) Spillover check valve spring 6, holds check valve (8) to its seat.

(c) Diaphragm spring 7, holds the slide valve to its seat when the diaphragm is balanced.

(d) Vent valve spring 20, holds the emergency vent valve to its seat.

(e) Inshot check valve spring 25, holds the check valve in contact with inshot piston stem

(f) Emergency piston spring 28, resists movement of the spring guide in the piston stem.

(g) Return sprang 31, returns the piston and slide valve to normal release position when brake pipe and quick-action chamber pressures are equalized.

(h) Graduating valve spring 34, holds the graduating valve to its seat on the slide valve.

(i) Inshot piston spring 48 resists inshot piston movement until brake cylinder pressure rises to 15 pounds.

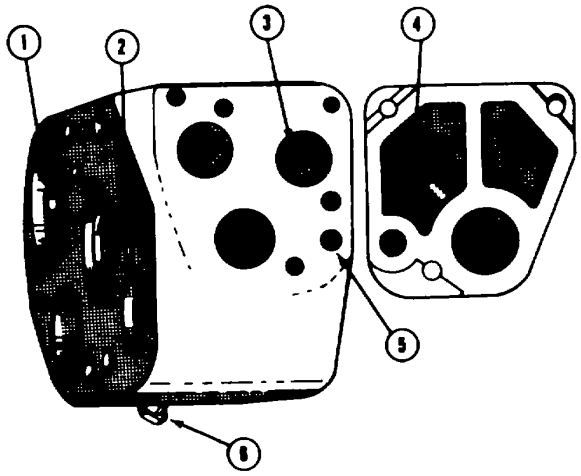


Figure 8-24. Location of the six emergency portion choke fittings.

(j) Spring identification. The following tabulation gives the Westinghouse Airbrake data necessary to identify each of the springs described.

Table 8-2. Spring Identification AB Emergency Portion

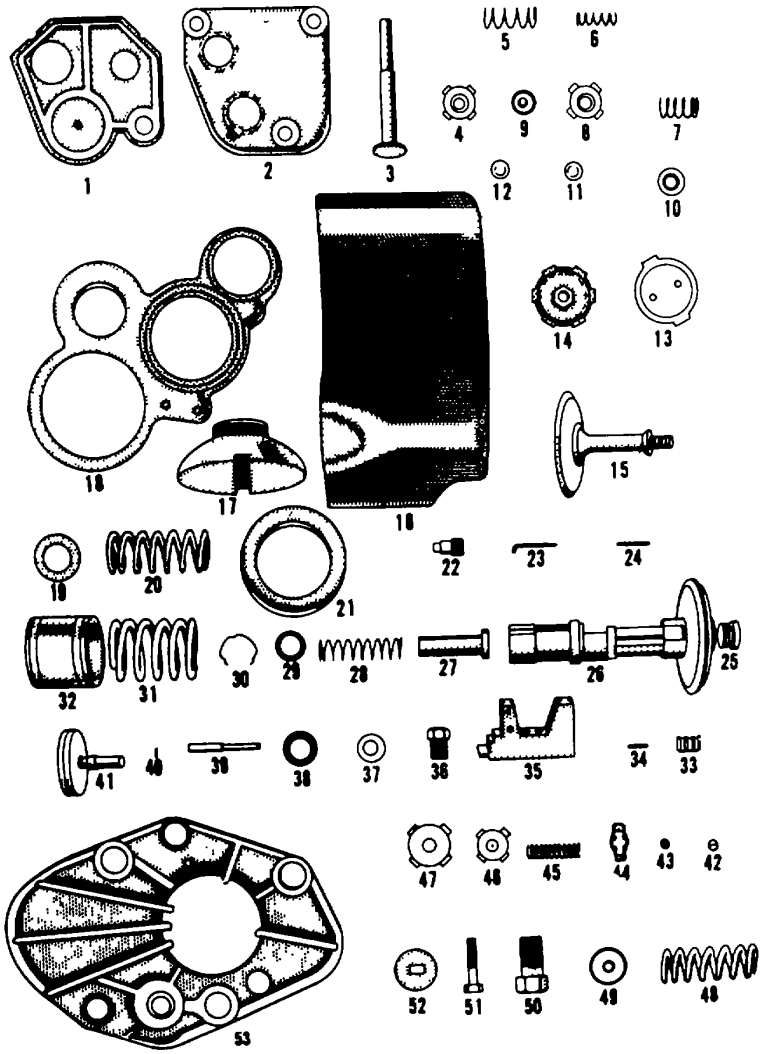
Reference No	Part No	Approximate 0. D.	Approximate diameter wire	Approximate free height	Approximate No turns	Material
5	A94952	3/4"	.072"	1 13/32"	7	Ph Bronze
6	A94581	3 1/64"	.028"	1 3/32"	7	Ph Bronze
7	A94839	11/16"	.064"	1 1/8"	6 1/2	Ph Bronze
20	A81643	1 3/8"	.121"	2 23/32"	71,/2	Steel
25	A94836	33/64"	.050"	1 23/32"	14	Ph Bronze
28	A501006	13/16"	.062"	2 13/32"	11	Steel
31	A500944	1 27/32"	.187" sq.	2 29/64"	6	Steel
84	A93940	5/32"	.020"	21/32"	12	Ph Bronze
48	A95032	1 3/16"	.098"	11/32"	8	Steel

(3) *Inspection, lubrication, and assembly of parts*. Inspection, lubrication, and assembly of parts is the same as that of the service portion with the following exceptions:

(a) The main (emergency) piston cannot be removed without first removing the ball check cover and taking out the slide valve strut which holds the slide valve to its seat. Damage will result if force is used to remove the emergency piston from its bushing without first removing the strut.

(b) The springs behind the vent valve and the inshot valve are held in place by circular metal retainers which have lugs on two opposite sides. These lugs engage under a lip around the outer edge of the cavities in the body casting. To remove the spring and valve, press down on spring retainer and tilt it so that one lug is exposed upward. When in this position, the parts can be readily removed and can be reassembled by using the same method in reverse.

(c) If the vent protector chamfer at the exhaust of the emergency portion body is pitted excessively due to rust, refinish the surface with emery cloth or a suitable reamer. Do not remove



Legend for Figure 8-25

1 Emergency ball check cover gasket
2 Emergency ball check cover
3 Slide valve strut
4 Accelerated release valve check
5 Accelerated release valve check spring
6 Spillover check valve spring
7 Diaphram spring
8 Spillover check valve
9 Accelerated release check valve spring seat
10 Diaphragm spring seat
11 ⅜-inch spillover ball check
12 ⅜-inch accelerated release ball check
13 Vent valve spring seat
14 Small vent valve piston
15 Large vent valve piston
16 Emergency portion body
17 Vent protector
18 Cover gasket
19 Vent valve piston seal
20 Vent valve spring
21 Vent valve piston seal
22 ⅛-inch choke (3/32" drill) inshot valve delay choke
23 Slide valve spring pin lock (2)
24 Slide valve spring pin (2)
25 Piston oil plug
26 Emergency piston
27 Emergency piston spring guide
28 Emergency piston spring
29 Emergency piston spring seat
30 Emergency piston spring seat retainer
31 Return spring
32 Return spring cage
33 Graduating valve
34 Graduating valve spring
35 Emergency slide valve
36 ¼-inch pipe plug
37 Inshot piston nut
38 Inshot piston seal
39 Inshot piston stem
40 Pin
41 Inshot piston and stem
42 ⅛-inch choke plug (5/64" drill) timing valve
43 ⅛-inch choke plug (3/32" drill) inshot valve delay choke
44 Inshot check valve spring retainer
45 Inshot check valve spring
46 Inshot check valve
47 Timing valve
48 Inshot piston spring
49 Inshot piston spring seat
50 Hex head capscrews (3)
51 Hex head capscrews (3)
52 Inshot piston spring shims
53 Emergency portion cover

Figure 8-25. Emergency portion body and parts.

any more material than is necessary to obtain a clean surface The chamfer must be held to a 45° angle to insure proper fit and tightness of vent protector.

(d) When the vent valve piston and the inshot valve piston are assembled to the body, place two drops of oil in the piston ring groove. Rotate the ring in the groove to distribute the oil. Insert the piston in the body and then evenly spread three drops of oil around the piston bush. Move the piston back and forth several times and then remove the surplus oil from the outer edge of the cylinder.

(4) *Performance of code of tests.* Install reconditioned valve portion on test rack and perform code of tests in accordance with instructions in TM 55-2006.

8-16. Shop Maintenance of AB-1-B Control Valve

a. General. Maintenance of the AB-1-B Control Valve is the same as the AB Control Valve (para 8-15), except for the addition of a filling piece with selector valve portion, located between the emergency portion and the pipe bracket.

b. Disassembly. Refer to figure 8-26, and disassemble the parts as illustrated. Use extreme care when dismantling the parts to avoid mutilation or damage to springs, gaskets, diaphragms, seals, and like items.

c. Cleaning and Inspection

(1) Wash all parts in a suitable solvent that will remove oil and grease. Do not allow gaskets and rubber-seated valves to soak in the cleaning fluid.

(2) Inspect valves and valve seats for wear pitting or scoring. Recondition or renew as required.

(3) Check springs for rust pits, distortion, breaks, cracks, and permanent set. The springs should have a free height of 1 1/2 inches

.

(4) Replace all gaskets and diaphragms that have broken or flattened beads, cracks, swelling, or cuts on diaphragm sealing surfaces. Coat all gaskets and diaphragms with dry graphite before replacing.

(5) Inspect wasp excluder for defects. Clean wire mesh with compressed air. Renew if found defective.

d. *Reassembly.* Refer to figure 8-26, and reassemble the parts as illustrated. Tighten nuts and capscrews evenly, but not excessively to cause distortion of covers and gaskets.

8-17. Shop Maintenance of A-2-A Quick-Service Valve

a. General

(1) The A-2-A quick-service valve consists of a pipe bracket and valve portion. The brake pipe strainer used in the pipe bracket is identical to the strainer used in AB control valve pipe bracket.

(2) Three springs and one choke are used in the valve portion. They are identified in figure 8-27 by reference numbers as follows:

(a) Choke (3) with filter controls the charging of the quick-service volume reservoir. It is located in the valve portion body under the strut diaphragm cover. Attached to the choke plug is a filter felt which prevents restriction of the choke by very fine dirt, thereby insuring the proper charging rate of the quick-service volume reservoir. Orifice size No. 73 drill.

(b) Spring (11) holds the piston slide valve to its seat.

(c) Check valve spring (10) seats the cutoff valve check valve.

(d) Diaphragm follower spring (8) seats the diaphragm follower.

(e) The following tabulation gives the data necessary to identify each of the springs described.

Table 8-3. Spring Identification A-2-A Quick-Service Valve

Reference No.	Part No	Approximate . O. D.	Approximate diameter wire	Approximate free height.	Approximate No turns	Material
11	A94839	11/16"	.065"	1 1/8"	6 1/2	Ph Bronze
10	A513914	11/16"	.072"	1 1/16"	8	Steel
8	A513913	1 5/32"	.072"	1 15/16"	7	Steel

b. Disassembly

(1) Remove nuts (24) (fig 8-27) from strut diaphragm cover (22) and remove cover.

(2) Remove slide valve strut (23), piston (14), and slide valve (16). The remaining operating portions can now be readily removed from the valve body. Take care to avoid distortion or damage to parts with respect to piston springs, gaskets, diaphragms, slide valve, and like items.

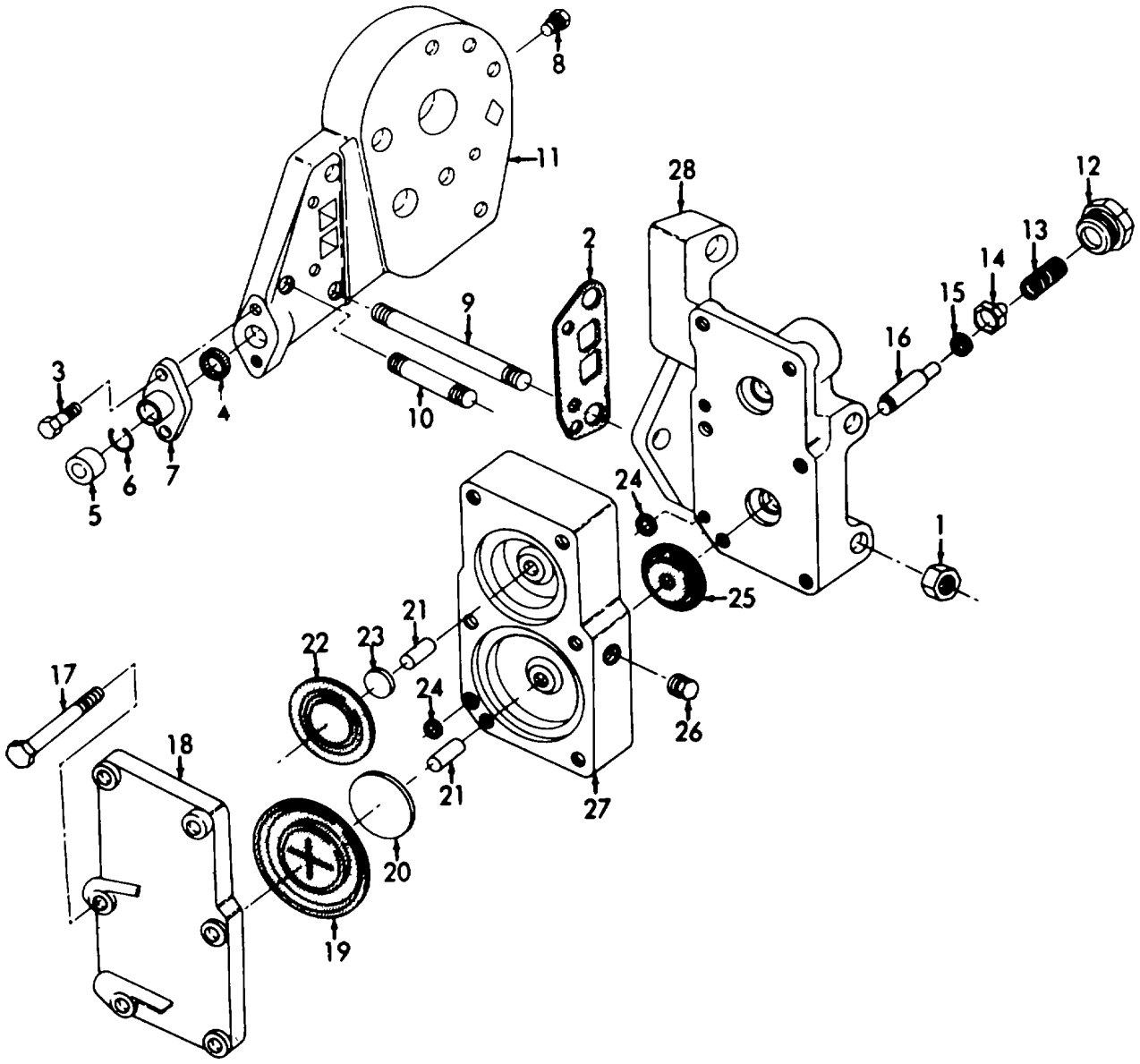


Figure 8-26. Filling piece and selector valve portion.

c. Cleaning. Wash all metal parts in approved solvent that will dissolve oil and grease without abrasion. Dip all gaskets and rubber seated parts in approved solvent to assist in removal of grease and dirt and immediately wipe dry after cleaning. Do not soak the parts in the cleaning fluid. Blow out all air passages with compressed air.

d. Inspection and Maintenance

(1) Replace all gaskets which have broken or flattened beads or any that reveal cracks or cuts on diaphragm or sealing surfaces. Brush serviceable gaskets with a soft bristle brush (such as a shoe brush) to remove any remaining dirt and to give them a polish.

(2) Check the piston bushing for ring size by using a cylinder gage.

(3) Remove the filter felt in choke (3). Clean and replace or renew if damaged. If the choke is the earlier type which does not have a filter felt, replace with the latest design.

(4) Reconditioning of the slide valve and piston is the same as for the AB control valve (para 8-15b(4) and (6)).

(5) Inspect springs (8), (10), and (11) for rust pits, distortion, breaks, cracks, or permanent set. Renew all springs that are defective.

e. Assembly of Parts to Body

(1) Press the side of piston ring opposite the scarf to the bottom of the ring groove. Apply three drops of lubricating oil through the ring scarf opening. Restore the ring to normal position and rotate ring in groove to distribute the oil. Position the ring scarf approximately 1 inch on either side of piston top center.

(2) Apply a few drops of lubricating oil to piston bushing and distribute evenly over the entire surface. Distribute one drop of oil on the collar at the piston spring end of piston, then insert piston and slide valve in the body.

(3) Assemble balance of parts in reverse of removal, using new parts as required.

f. Performance of Code of Tests. Install reconditioned valve on test rack and perform code of tests in accordance with TM 552023.

8-18. Shop Maintenance of AB Brake Cylinder

a. Disassembly

(1) Remove shipping cap and place piston assembly on a clean workbench.

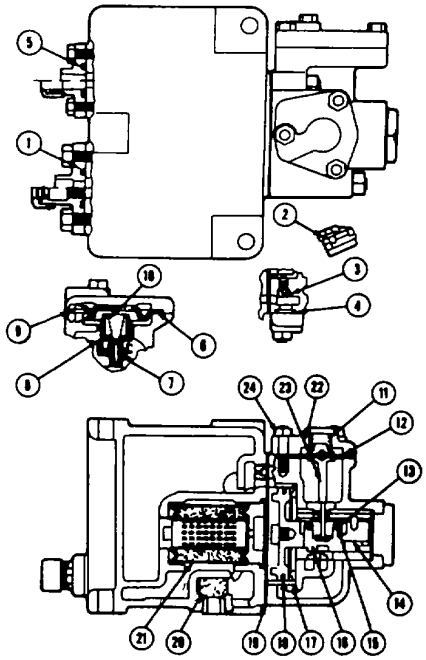
(2) Remove packing cup (4) (fig 8-28) with a wood tool about I inch wide and 1/8 inch thick, with rounded edges to prevent damage to packing cup and piston lubricator.

(3) Place piston and nonpressure head in a holding fixture which will hold the compression spring partially compressed.

(4) Remove collar from end of hollow rod

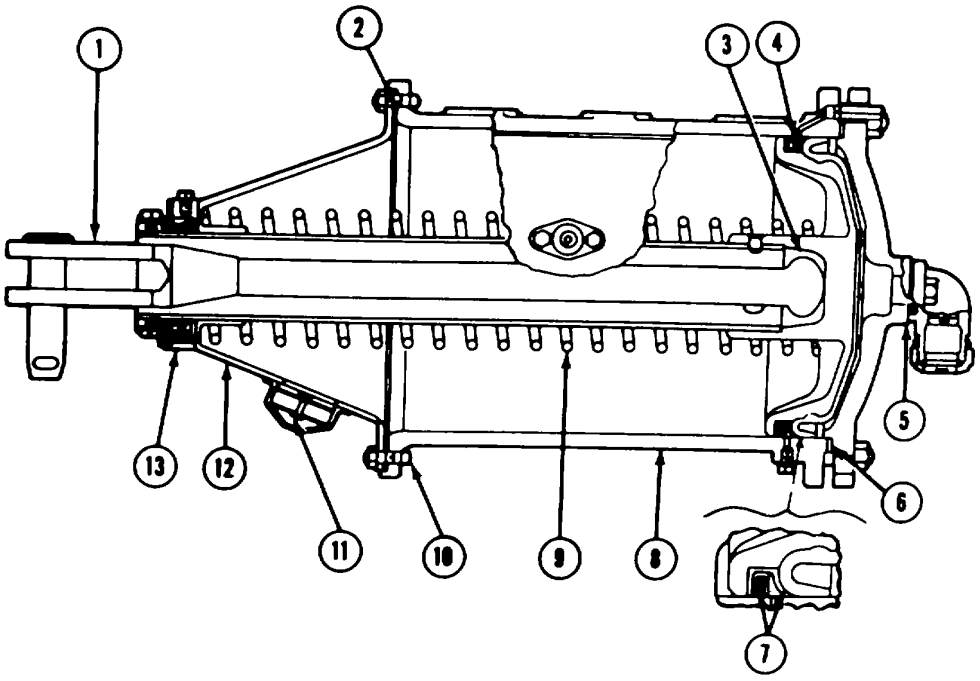
(3), then remove retaining plate and packing seal (13).

(5) Remove nonpressure head and compression spring (9) from the hollow rod.



1 Flange fitting gasket
2 ½-inch port gasket
3 Strainer choke
4 ¾-inch port gasket
5 ⅜-inch flange fitting gasket
6 Cut-off diaphragm
7 Cut-off valve
8 Diaphragm follower spring
9 ⅛-inch port gasket
10 Check valve spring
11 Diaphragm compression spring
12 Slide valve diaphragm
13 Slide valve pin
14 Piston assembly
15 Slide valve lockring
16 Slide valve
17 Plain seal
18 Piston ring
19 Body gasket
20 Strainer
21 Strainer
22 Diaphragm cover
23 Valve strut
24 Nut

Figure 8-27. Assembly view of A-2-A qutck-serice valve.



1 Push rod
2 Nonpressure head gasket
3 Piston and hollow rod
4 Packing cup
5 Union gasket
6 Pressure head gasket
7 Piston lubricator swab
8 Cylinder body
9 Compression spring
10 Tee head bolts
11 Strainer assembly
12 Nonpressure head
13 Packing seal

Figure 8-28. AB brake cylinder, showing air pipe connection when used with automatic slack adjuster.

b. Cleaning, Inspection, and Maintenance

(1) Blow all dirt out of the nonpressure head and strainer.

(2) Using a scraper and solvent, clean the seal recess in the nonpressure head gasket face.

(3) With a tile, break any sharp edges from the ends of the opening in the nonpressure head 'which guides the hollow rod.

(4) Clean the piston and the hollow rod, removing any rust or rough surfaces; use emery cloth if necessary.

(5) Examine the compression spring. If rust ,spots are found, clean them with emery cloth and coat the spring with a rust preventive.

(6) Clean the seal ring retaining plate and the seal rings, renewing any ring which does not close firmly on the hollow rod.

(7) Thoroughly clean the packing cup (4) with solvent and clean the piston lubricator as follows:

(a) Submerge the piston lubricator in a tank of solvent for a few minutes; then loosen the lubricator swab in its groove with a thin round edge blade. Return the lubricator swab to the solvent tank long enough to dissolve the grease.

(b) Brush the outer surface of the lubricator swab with a handbrush and blow dry with compressed air.

(c) Renew the lubricator swab if it is ,damaged, worn out, or in such a condition that it cannot be loosened and raised in its groove to make a full contact against the cylinder wall.

(d) Submerge the clean lubricator in a tank of oil. Soak in the oil for at least 10 minutes and allow it to drain for about 10 minutes This will saturate the lubricator swab with oil and thereby prevent it from absorbing the brake cylinder lubricant.

c. Reassembly

(1) Apply a light coat of brake cylinder lubricant to the hollow rod and place the piston and hollow rod in a holding fixture. Then apply the compression spring (9) and nonpressure head (12) Use the locking mechanism of the fixture to hold the compression spring partly compressed.

(2) Place the hollow rod lubricator swab over the hollow rod and push into the recess in the nonpressure head. Put the swab compression ring -on the inner portion of the assembly tool; then slide the tool over the outer end of the hollow rod until it contacts the lubricator swab. With the tool held in this position, push firmly on the outer portion forcing the swab compression ring off the tool into position around the lubricator swab. Insert brake cylinder lubricant in the nonpressure head recess until the space is about 1/3 full. Place the swab retainer over the lubricator swab; then assemble the seal rings with their openings staggered. Completely fill the recess with brake cylinder lubricant and apply the seal ring retaining plate. Fasten it with capscrews secured with lockwashers.

(3) Apply the piston, lubricator (7) to piston with flat (felt) side next to piston. Apply the packing cup (4) to piston by starting the cup over the edge of piston; while holding it in this position, work the cup into place with the hands. If the cup does not seat properly because of trapped air, the air can be removed by raising one side of the cup and pushing the cup into place with the hands.

(4) Apply shipping cap over the assembled piston and secure with bolts to nonpressure head.

8-19. Shop Maintenance of Engine Portion of Automatic Slack Adjuster

a. Disassembly of Engine Portion

(1) Remove snap ring (31) (fig 8-29) at end of the ratchet nut bearing. Then remove the ratchet assembly from the adjuster body end of the casing (27).

(2) Remove check pawl ring (34), pawls (28), pins (29), and springs (30).

(3) Remove ratchet nut felt (11) at the end of ratchet nut bushing (33).

(4) Remove piston packing cup (21) by using a wooden tool with rounded edges about 1 inch wide and 3/32-inch thick, to prevent damage to packing cup and piston lubricator swab (18) and retainer (20).

(5) Remove the lubricator swab (18) and retainer (20).

b. Cleaning, Inspection, and Maintenance

(1) Thoroughly clean all parts in solvent to remove oil, grease, and dirt.

(2) Renew all worn or damaged parts.

(3) Clean the piston lubricator swab and retainer as follows:

(a) Submerge the assembly in a tank of solvent for a few minutes. Then loosen the lubricator swab in its groove with a thin round-edge blade. Return to solvent tank to dissolve the grease from the swab. Brush the outer surface of the swab with a handbrush to aid in removing the old grease. After the swab is thoroughly clean, dry with low pressure air.

(b) Renew the lubricator swab when it is worn, damaged, or in such condition that it cannot be loosened and raised in its groove to make full contact with the cylinder.

(c) Submerge the cleaned piston lubricator in a tank of new journal box oil for at least 10 minutes. Then allow the assembly to drain for about 10 minutes. This saturates the swab and prevents absorption of oil from the brake cylinder lubricant.

c. Reassembly of Engine Portion

(1) Lubricate the cylinder wall and piston packing cup (21) with brake cylinder lubricant.

(2) Place the piston spring (26) in the pocket of the casing (27). Place the piston (22) on top of the spring and apply the cylinder to the piston over the packing cup.

(3) Apply pressure to force the cylinder into place against the resistance of the piston spring. Before pressure is applied and during application of pressure, hold the knockout lug away from contact with pawl stop (25) to prevent rupture of this part. The knockout lug is part of pawl (14) which is accessible through the adjuster body opening in casing (27). The pawl can be reached by removing pipe plug (15).

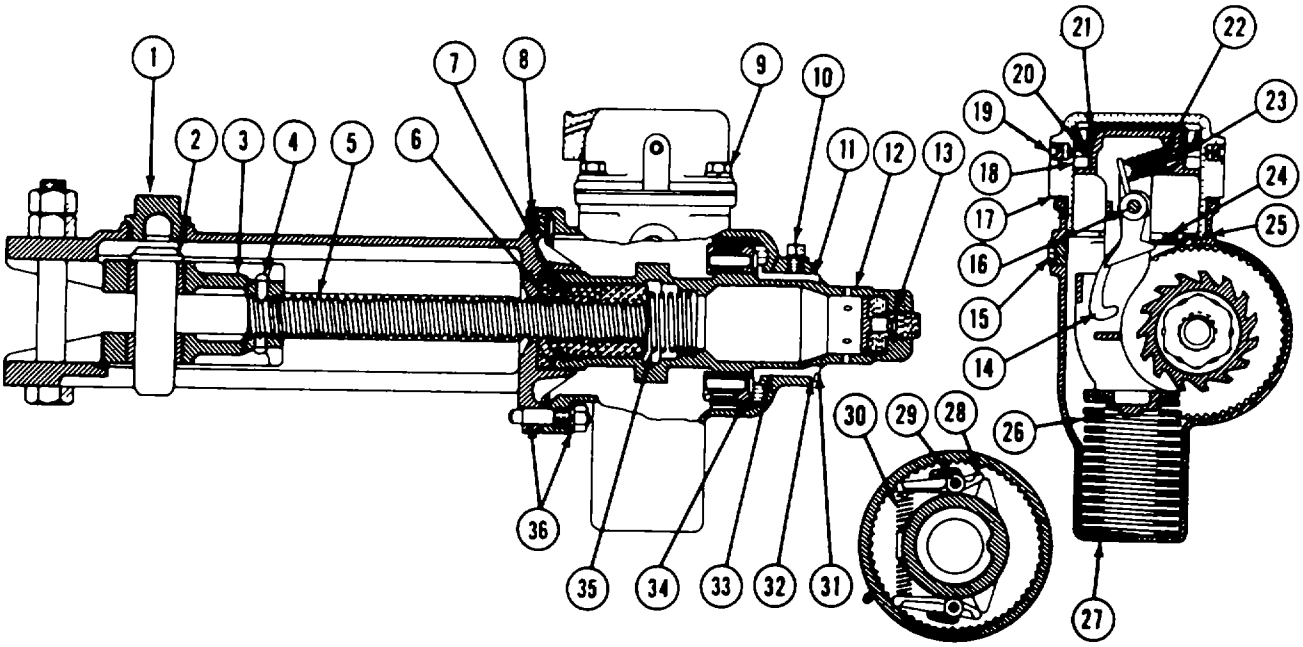
(4) Stand the ratchet assembly on the brass nut end and reassemble the pawl ring, pawls, pins, and springs on the ratchet nut. Lubricate these parts and the ratchet nut bearing with 6 ounces of graphite grease.

(5) Lower the casing (complete with piston and spring) in position over the ratchet nut.

Saturate the ratchet nut felt (11) with journal oil and put in place next to the ratchet nut bushing (33). If the felt is so worn that it does not seal against the ratchet nut, renew the felt.

(6) Replace felt retainer (32) and snapring (31).

(7) Protect reconditioned engine portions against damage and entrance of dust and dirt during storage.



1	Crosshead	10	Oil plug (2 ea)	21	Packing cup	30	Check pawl spring (2 ea)
2	Crosshead pin	11	Ratchet nut felt	22	Piston	31	Snap ring
3	Crosshead cap	12	Ratchet nut	23	Pawl spring	32	Felt retainer
4	Crosshead rivet	13	Stop plug	24	Pawl stop screw (2 ea)	33	Ratchet nut bushing
5	Adjuster screw	14	Pawl	25	Pawl stop	34	Check pawl ring
6	Adjuster screw nut	15	Pipe plug	26	Piston spring	35	Adjuster screw nut spring
7	Packing ring	16	Pawl pin	27	Casing	36	Casing bolt & lockwasher (3 ea)
8	Bolt hole plug	17	Cylinder	28	Check pawl (2 ea)		
9	Cylinder cap screw (4 ea)	18	Swab	29	Check pawl pin (2 ea)		
		19	Cylinder plug (2 ea)				
		20	Swab retainer				

Figure 8-29. Slack adjuster, automatic type, assembly view.

Section V. SINGLE-CAPACITY FREIGHT CAR 'BRAKE EQUIPMENT (K)

8-20. Features

a. General. The type K triple valve illustrated and described in this manual, formerly standard for the single cylinder form of freight car brake equipment, possesses the features of quick action, quick service, uniform release, and uniform recharge. The K brake equipment has been replaced in CONUS by the AB type and is no longer accepted in interchange service by US railroads. However, much US Army-owned rolling stock used within CONUS installations and in oversea areas is equipped with K brake equipment, so its features are discussed herein for the information of TRS maintenance personnel who may be unfamiliar with this type of freight car brake.

b. Quick-Action Feature. This functions when a emergency rate of brake pipe reduction takes place from any cause. This feature insures a quick drop of brake pipe pressure (by opening direct communication between the brake pipe and the brake cylinder) at the triple valve which in turn causes the next triple valve to function in the same manner, thereby propagating the emergency rate of brake pipe reduction and securing maximum brake cylinder pressure through the entire train at a fast rate.

c. Quick-Service Feature. This feature produces uniform and quick application of the brakes in service applications on long trains and reduces shocks. There are two service positions of the triple valve ports, quick service and full service. When the valve is in quick-service position, the usual service port is only partially open and in addition the quick-service ports are in registration so that air is vented from the brake pipe into the brake cylinder, which hastens the transmission of the reduction through a train. When the parts are in full-service position, the service port is fully open and the quick-service ports do not register. The proper position is automatically assumed by the triple valve. On short trains the brake pipe pressure will fall more rapidly for a certain reduction at the brake valve than on long trains. Consequently, when the train is long the triple valve ports will be stopped in quick-service position, as the partial opening of the service port will permit the auxiliary reservoir pressure to fall as rapidly as the brake pipe pressure is reducing. But when the train is short, the triple valve ports will move directly to full service position as the rate of reduction is such that the full opening of the service port is necessary in order that the auxiliary reservoir pressure may keep pace with that in the brake pipe.

d. Uniform Release Feature. This brings about uniform release of the brakes on long trains and ,lessens the possibility of shocks during the release operation. A spring is placed on the auxiliary reservoir end of the triple valve with a projecting stem which stops the triple valve slide valve in what is called full release position, unless the pressure in, the brake pipe is raised materially higher than that of the auxiliary reservoir. When the pressure in the brake pipe is in-creased about 3 pounds above that of the auxiliary reservoir, the spring is compressed and the slide valve consequently makes a further inward travel to *retarded release* position, partially closing the exhaust port and thereby making the release of brake cylinder pressure slower than before. In a 50-car train or longer, it is impossible to raise the brake pipe pressure 3 pounds higher than the auxiliary reservoir for more than 30 cars back in the train; therefore, the brake cylinder exhaust is retarded only on the first 30 cars, those beyond releasing at the normal rate; but as those at the head end commence to release first and those at the rear end last, the result is a practically uniform release on the train as a whole.

e. Uniform Recharge Feature. This feature insures that the recharge will be nearly uniform throughout a long train, so that the tendency of the head brakes to reapply is reduced when the brake valve is returned to running position, and a more nearly uniform reapplication short after a release is possible. This uniform recharge is brought about by decreasing the size of the charging port or grooves when the triple valve is in retarded release position (the piston sealing against the slide valve bush, except at one point where there is a feed groove smaller than that in the piston bush), and as this can only be when the pressure in the brake pipe is higher than that in the auxiliary reservoir, it is seen that where the pressure is the highest the charging ports ,are the smallest, while where the pressure is the lowest, as at the rear end, the charging ports are the largest; thus, the recharge is more uniform because the high pressure will charge as quickly through a small port as the low pressure will through a large port.

8-21. Equipment Parts

a. General Following is a list of the parts which make up the single capacity K freight car brake equipment, with a short description of each. These parts (fig 8-30) are discussed in detail in subsequent paragraphs.

b Triple Valve Type K. This has connections through its seat on the auxiliary reservoir to the brake cylinder and the auxiliary reservoir, and a pipe connection to the brake pipe branch pipe. It operates in response to a suitable increase or decrease in brake pipe pressure, so as to charge the auxiliary reservoir by opening communication to it from the brake pipe; apply the brakes in service, by allowing the compressed air stored in the auxiliary reservoir to flow into the brake cylinder; and release the brakes, by allowing the lair in the brake cylinder to escape to the atmosphere.

c. Brake Cylinder. This has a piston and rod is connected through the brake levers and rods to the brakeshoes that when the piston is forced

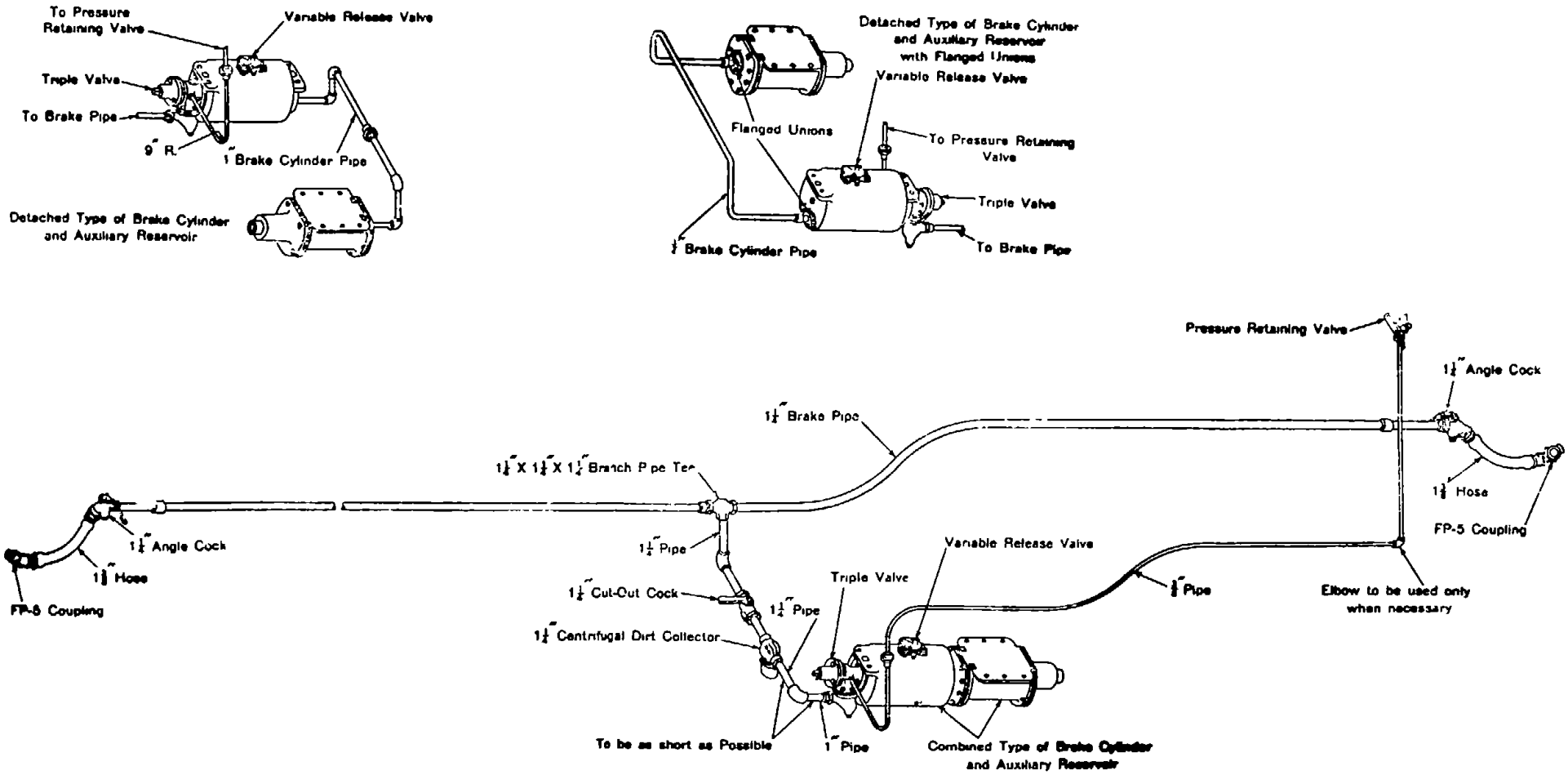


Figure 8-30. Piping diagrams of KC freight car brake equipment with type K triple valve.

outward by air pressure, this force is transmitted through the rods and levers to the brakeshoes and applies them to the wheels.

d. Auxiliary Reservoir. This contains stored air for use in applying the brakes.

e. Centrifugal Dirt Collector. This is connected in the branch pipe between the brake pipe (and the triple valve as near the triple valve as circumstances will permit, and is for the purpose of preventing pipe scale, sand, cinders, or foreign particles of any kind from reaching the triple valve.

f. Branch Pipe Tee. This tee is to prevent the deposit in the branch pipe of excessive moisture from the brake pipe.

g. Pressure Retaining Valve. This valve is connected by piping to the triple valve exhaust, its purpose being when the handle is placed in retaining position, to retard the rate of brake cylinder exhaust while the engineman is recharging the auxiliary reservoirs and when brake cylinder pressure has been reduced to a certain predetermined amount, to retain that pressure in the brake cylinder.

h. Release Valve. This is attached to the auxiliary reservoir, by means of which the brake may be released when desired by bleeding the reservoir.

i. Cutout Cock, Angle Cocks, Hose, and Hose Couplings. The location and uses of these items will be readily understood from the isometric view of the equipment, figure 8-30 and the descriptions which follow.

8-22. Description of Parts

a. Triple Valve. The type K triple valve is manufactured in two sizes, the K-1 for use with 6-inch and 8-inch freight car brake cylinders, corresponding to the J-1 (F36), and the K-2 with 10-inch freight car brake cylinders, corresponding to the H-2 (H49). The K-1 will bolt to the same reservoir as the H-1 and K-2 to the same reservoir as the H-2. Figures 8-31 and 8-32 are sectional views of the K-1 and K-2 types, respectively. Each valve is marked with its designation on the side of the valve body, and the K-2 may be distinguished from the K-1 by the fact that it has three, as compared with two, bolt holes in the reservoir flange. Also, in order to distinguish the type K valves from the old standard type, their exterior being similar when they are attached to the auxiliary reservoir, a lug is cast on the top of the valve body, as shown in the illustrations. This enables them to be easily recognized.

b. Port Connections, etc.

(1) *Openings*. As shown in figures 8-31 and 8-32, the retarding device body projects into the auxiliary reservoir and is constructed so that free communication exists between the auxiliary reservoir and chamber R, in which the slide valve 3, and graduating valve 7, operate The opening marked "To Brake Cylinder," figures 8-31 and 8-32, comes opposite one end of the tube which leads through the auxiliary reservoir to the brake cylinder, when the valve is bolted in place on the end of the auxiliary reservoir, as shown in section in the diagrammatic views. The letter designating the ports and passageways, and the reference numbers designating the parts appearing in the illustrations, correspond throughout.

(2) *Port designations.* As illustrated in the isometric view of the slide valve seat, figure 8-33, the ports are as follows:

(a) r leads to the brake cylinder and also connects with chamber X over the emergency valve and under the emergency piston.

(b) y leads to the check valve case and chamber Y.

(c) t leads to the top of the emergency piston.

(d) p leads to the exhaust (or retaining valve).

(e) Ports o on top and bottom of slide valve connect and are alike in size. Port q runs directly through the slide valve, but is smaller at the top than at the face of the valve, and the smaller port is out of center with the larger port. Ports s and z run through the valve and connect with cavities in the face, port z also has a cavity at the top.

(f) The face view of the graduating valve shows that it has a small cavity v. This valve is of the slide valve type, and it seats on the top of the slide valve, where it controls the upper end of ports z, q and o. The purpose of the cavity v is to connect the upper ends of ports o and q in a service application, as explained in detail later.

(g) As shown by the face view of the slide valve, n is a long cavity connected by a restricted port to a "tail port" at its right-hand end. This cavity n connects the ports through which the air escapes from the brake cylinder in releasing. Port b is cut diagonally from the face of the valve till it just cuts into the edge, at the top of the slide valve. It admits auxiliary reservoir pressure to port t in an emergency application.

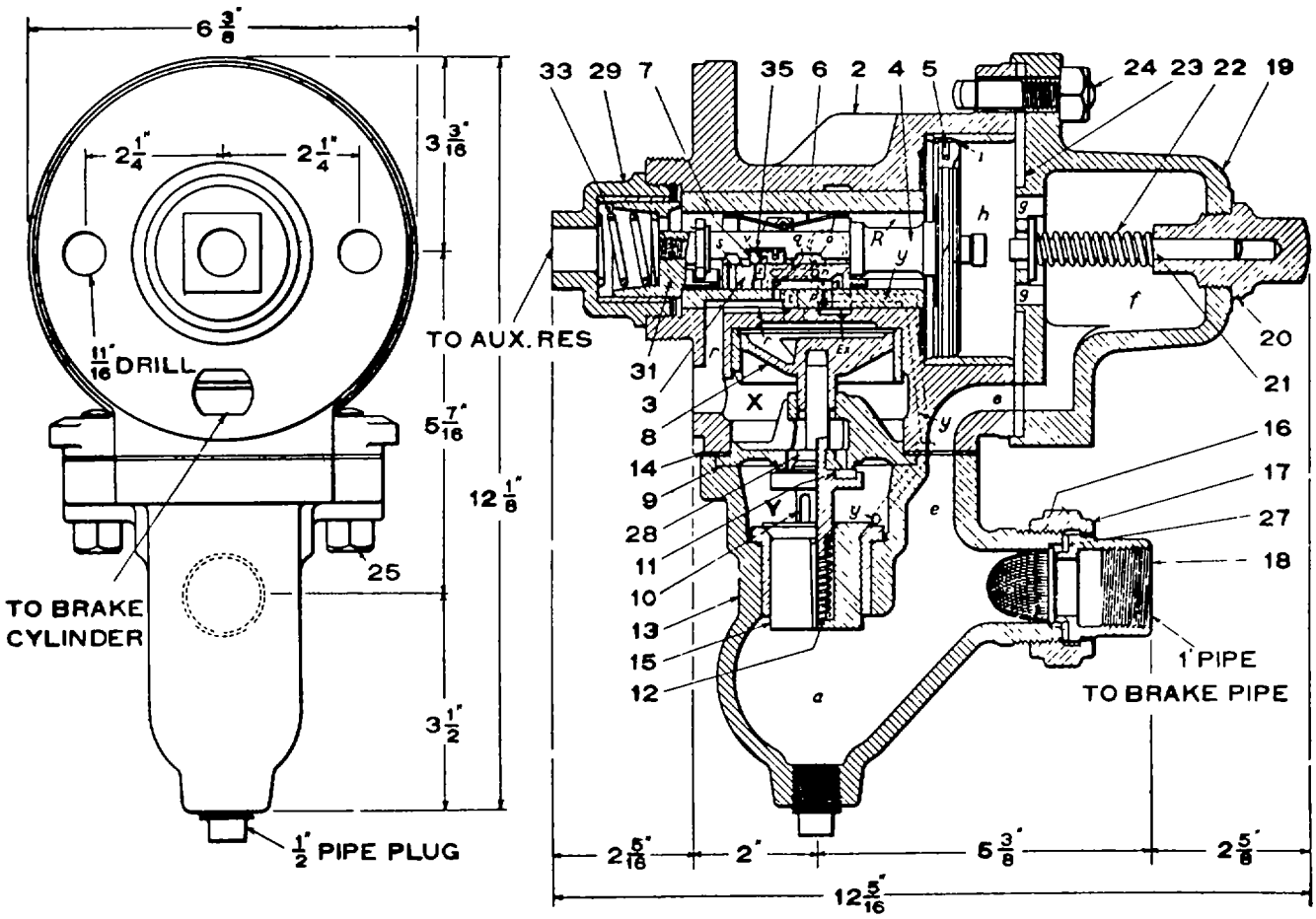


Figure 8-31. K-1 triple valve, actual section and end view

c. Brake Cylinder and Reservoir

(1) *Auxiliary reservoir.* A standard castiron auxiliary reservoir is included with the complete freight brake set, which is furnished either combined with the brake cylinder (type KC, see fig 8-34), or detached therefrom, as desired, according to the conditions of the installation. This reservoir is of such volume that with an initial auxiliary reservoir pressure of 70 pounds and standard (8-inch) piston travel, the brake cylinder and auxiliary reservoir pressures will equalize at 50 pounds.

(2) *Piston.* The piston 3 of the brake cylinder has a hollow sleeve in which is the loose push rod attached to the levers and rods of the foundation brake rigging; 9 is a release spring which forces piston 3 to release position when the air is exhausted from the opposite end of the cylinder; the packing cup presses against the cylinder wall and prevents the escape of air past the piston. In the combined equipment the auxiliary reservoir forms the pressure head for the brake cylinder; in the detached equipment, 18 is the pressure head. *Excessive piston travel* will result in damage to the protector 20 (if used) and *must not be permitted.*

d. Wabcotite Fittings

(1) *Purpose.* The purpose of the Wabcotite fittings is to produce pipe joints which can be made and maintained permanently airtight and at the same time avoid costly failures in road service due to the breakage of pipe or fittings. The fitting is designed to clamp the pipe back of the threaded end so as to relieve the thread of tension stresses, and it is arranged so that removals and reapplications can be conveniently made.

(2) *Fittting arrangement.* The sectional view, figure 8-35, illustrates the construction details of the Wabcotite fittings. Tightening the clamping nut will cause the anchor ring to close in and grip the pipe firmly so that all bending

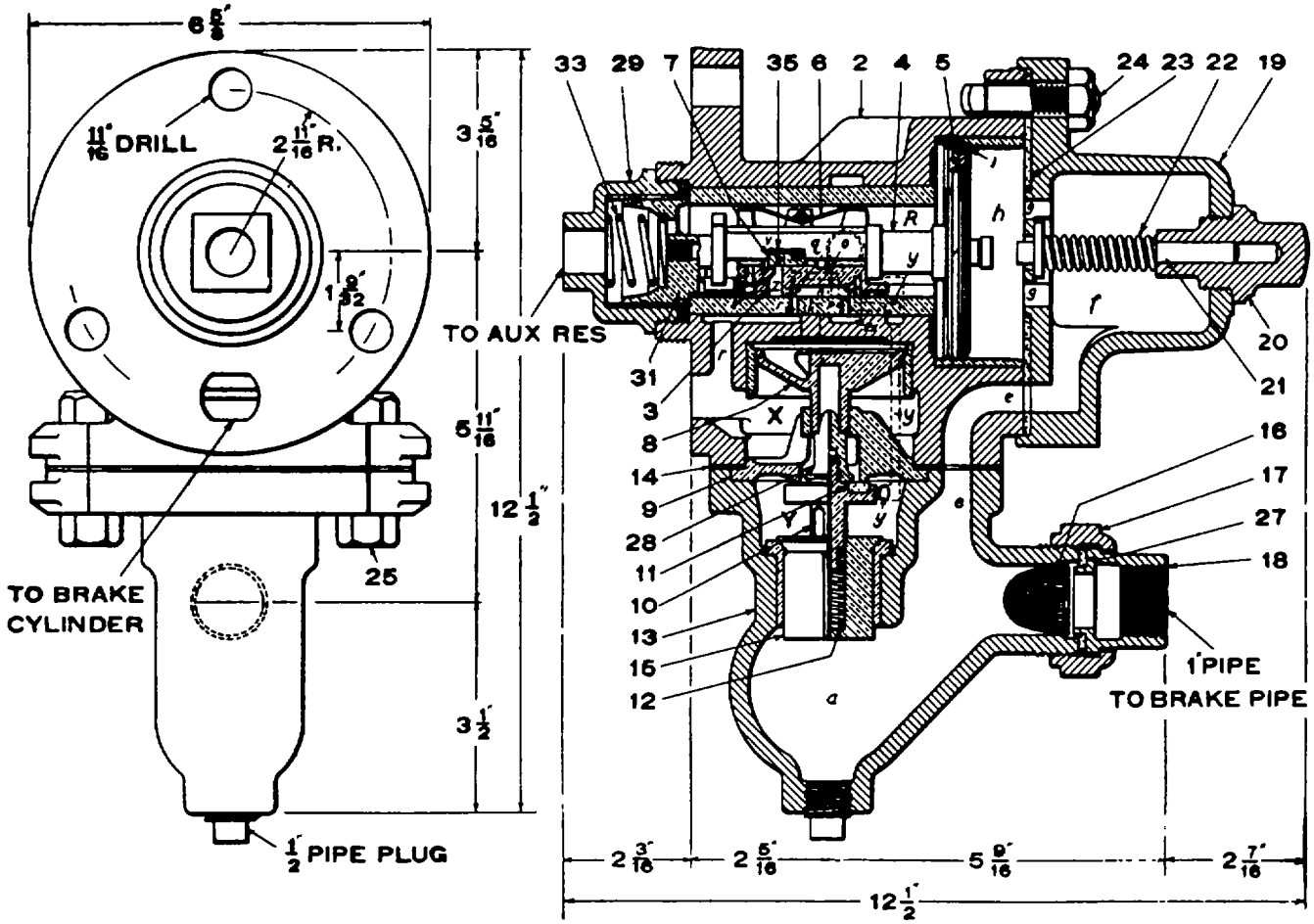


Figure 8-32. K-2 triple valve, actual section and end view

strains are removed from its weakest point and concentrated at its strongest point. The gasket is under an initial strain, but it is not subject to any subsequent movement because the union flange is drawn up solid, metal to metal (fig 8-36).

e. Centrifugal Dirt Collector

(1) *Location.* The centrifugal dirt collector is located in the branch pipe in order to protect the triple valve against the entrance of pipe scale, sand, cinders, dirt, or foreign substances of any kind. Figure 837 is a sectional view of the standard "Check Valve Type" in which the detachable enlarged dirt chamber and the check valve are the outstanding features. This design comprises two separate portions; the upper or body portion to which the pipe connections are made, and the lower or dirt chamber portion which contains the brass umbrella-shaped check valve. The two portions are bolted together and the joint between is protected by means of a rubber gasket. The detachable dirt chamber provides for easier cleaning, and the increased capacity permits longer time between cleaning periods (may be the same as for triple valve and brake cylinder).

(2) *Check valve.* The purpose of the check valve is to hold in the dirt chamber the collected dirt under all conditions of airbrake operation. The body portion has a machined seat against which the check valve seats when a heavy reduction in pressure occurs above it, such as that during an emergency application, thereby shutting off communication between the dirt chamber and the dirt collector outlet. The check valve is so designed and placed on the valve stem as to permit a rocking motion whereby any fine dust which may collect on top of the check valve will be shaken off into the dirt chamber.

f. Pressure Retaining Valve

(1) *Description.* The following description of the pressure retaining valve applies in detail

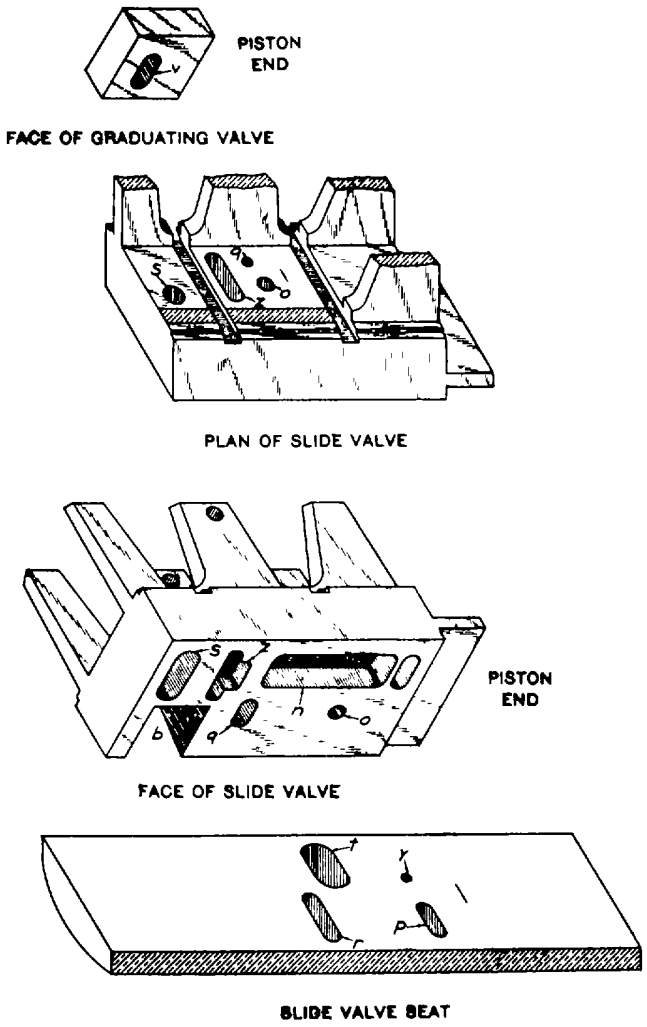


Figure 8-33. Isometric views of triple valve, slide valve and seat, and the graduating valve.

to the AAR standard. Many older types are in service which differ in detail, but the principle of operation is the same and that portion of the text covering operations, therefore, applies to the older as well as the newer types.

(2) *Standard retaining valve.* The standard retaining valve for freight equipment cars is a three-position, 10to 20-pound duplex spring type retaining valve having nominal blowdown valve of 50 seconds in the 10-pound position and 90 seconds in the 20-pound position. A wasp excluder fitting (g below) is provided in the exhaust opening to prevent the plugging of the exhaust by the entrance and nesting of mud wasps and other insects A fixed choke orifice (choke k) is incorporated in the passage (port g) between the high and low pressure cavities, and the springs and valves are permanently enclosed in the capnuts, thereby preventing possibility of spring distortion and assuring permanent closing valves. Both chokes k and h are drilled brass plugs and the choke ports are coned on the pressure side to prevent dirt from accumulating and closing the port.

(3) Adjusting the retaining valve. This valve is connected to the triple valve exhaust as illustrated in figure 8-30 and is adjusted by hand to permit either (a) the brake cylinder to exhaust freely to the atmosphere, or (b) to retain a portion of the air in the brake cylinder when making a release, in order to hold the brake applied while recharging the system. The retaining valve is usually fastened to the end of the car, near the brake staff, by lag screws or bolts.

(4) Lo*ck key.* The cock key, figure 8-38, has three outlets: one to the atmosphere through the pipe tap EXHAUST, one to the low pressure side of the retaining valve proper and another to the high pressure side. The valve portion consists of two valves 4 and 5 normally held to their seats by their springs 20 and 21 and holding ports *d* and e closed. When the handle of the retaining valve is turned down, passage *a* in the cock key connects chamber *D* and the outlet c to the atmosphere. When the handle is turned up to the horizontal position, passage *a* connects chamber *D* below the cock key with port *e,* so that when a release is made the air exhausting from the brake cylinder flows to the retaining valve and through passage *a* and passage e to the face of the valve 5 which it must lift against the pressure of spring 21 in order to flow to the atmosphere through the small vent port *h* in the low pressure capnut.

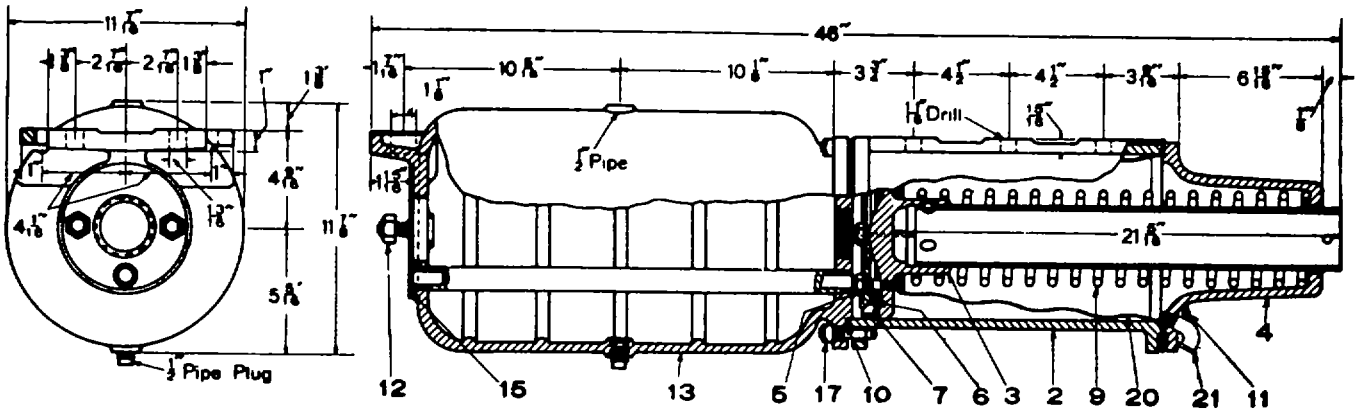


Figure 8-34. Sectional and end view 8 -by 12-inch freight brake cylinder and reservoir combined.

(5) Brake cylinder pressures. Spring 21 is capable of retaining a pressure of 10 pounds in the brake cylinder. As long as the pressure of the air from the brake cylinder is greater than this, valve 5 is unseated and the air exhausts to the atmosphere through the vent port which, being ,small, makes the release of the brake much slower than when the retaining valve is not used. When the pressure has been reduced to 10 pounds, it is no longer able to hold valve 5 off its seat and the valve then closes and the remaining 10 pounds is retained in the brake cylinder until the handle 5 is turned down. Failure of the pressure retaining valve to hold air in the brake cylinder generally is due to a leak in the connecting pipe, a frequent seat of trouble being at the union; it may also be due to a leak in the brake cylinders or in the retaining valve, but seldom in the latter. When it is desired to retain high pressure in the cylinder, the handle is placed in the intermediate position marked HP. In this position, passage *a* connects chamber *D* with port *d* so that the air pressure must lift valve 4 against the 10-pound value of spring 20. The air then 'passes through choke g to valve 5, which will be lifted from its seat against the 10-pound value of its spring 21, resulting in a pressure of 10 pounds in the spring chamber over valve 4. With 10 pounds air pressure plus 10 pounds spring pressure acting above valve 4, pressure of 20 pounds is required to unseat this valve. Consequently, 20 pounds air pressure will be retained in the brake cylinder. The air which is vented to atmosphere in this position passes valve 4, through choke *k,* valve 5 and through choke *h.* In passing through both chokes *k* and *h,* the flow of air is restricted so that release of the brake is slower than in *low pressure* position.

g. Vent Protector and Improved Wasp Excluder for Retaining Valve. Figure 8-39 illustrates a standard retaining valve with a vent protector (26) and an improved wasp excluder (23). The vent protector is molded Wabco and fits tightly over the low pressure capnut to protect the small vent port against the entrance of moisture which may cause corrosion and consequent restriction or stoppage of the port. The improved wasp excluder contains a flexible Wabco disc which normally maintains a seal against the entrance of water and wasps, but flexes readily to permit free exhaust of brake cylinder air through the retaining valve exhaust. The excluder is applied to the tapped exhaust opening by a hollow capscrew, having a cross port through which air passes to the excluder exhaust. Both the vent protector and the wasp excluder are applicable to retaining valves in service.

h. Four-Position Release Control Retainer

(1) *Features.* The four-position type of release control retainer (fig 8-40), accepted as a recommended practice by the AAR and acceptable on cars in interchange service in CONUS has the same features of the AAR standard retaining valve, plus a fourth position which affords a slowdown release of brake cylinder pressure from 50 pounds to 10 pounds in approximately 86 seconds. The purpose of this additional position is to provide a better control of slack in long freight trains during release of the brakes while the train is in motion, especially in cases where trains are operated over rolling country. The use

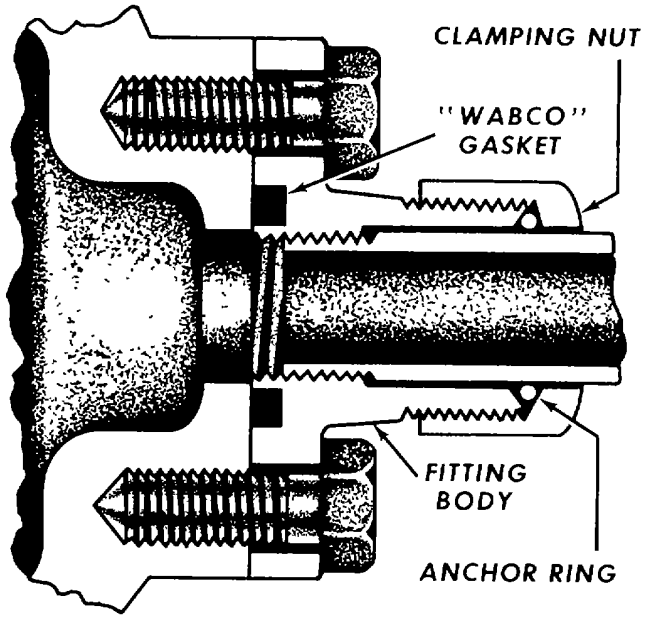


Figure 8-35. Wabcottie fitting as used on the brake cylinder and reservoir.

of this fourth or slow direct exhaust position avoids the necessity for resetting a retaining valve en route, especially on adverse grades. This new design of pressure retaining valve has many constructional features which are considered improvements over the former types. The valve is mounted upon a pipe bracket which is fastened permanently upon the car and to which the pipe connection is made. This arrangement makes it possible to remove the valve for cleaning and repairs without interfering with the piping. A strainer, similar in construction to the AB valve brake pipe strainer, is located in the bracket for cleaning the air before it passes to the valves and chokes within the retainer. A wasp excluder, similar to the separate unit now being furnished with the standard retaining valve is built into the retainer body casting. It consists of a flexible rubber diaphragm confined within a bell-shaped housing. A Wabcotite fitting connects the retainer pipe to the retainer pipe bracket. This insures against breakage of the pipe at this point. Provision is made for attaching the device for testing the brake cylinder, retainer pipe, and retainer without removal from the car.

(2) *Exhaust positions.* The exhaust of brake cylinder air through the release control retainer in the four-handle positions is as follows:

(a) In direct position, handle 5 is turned downward to the position marked EX. The triple valve exhaust is through strainer 25, chamber *A,* unrestricted passage g, and past wasp excluder 22 to atmosphere in unrestricted normal manner.

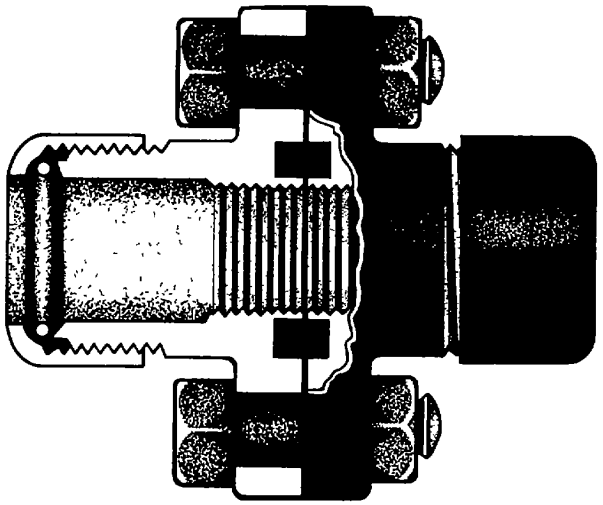


Figure 8-36. Wabcotite pipe union.

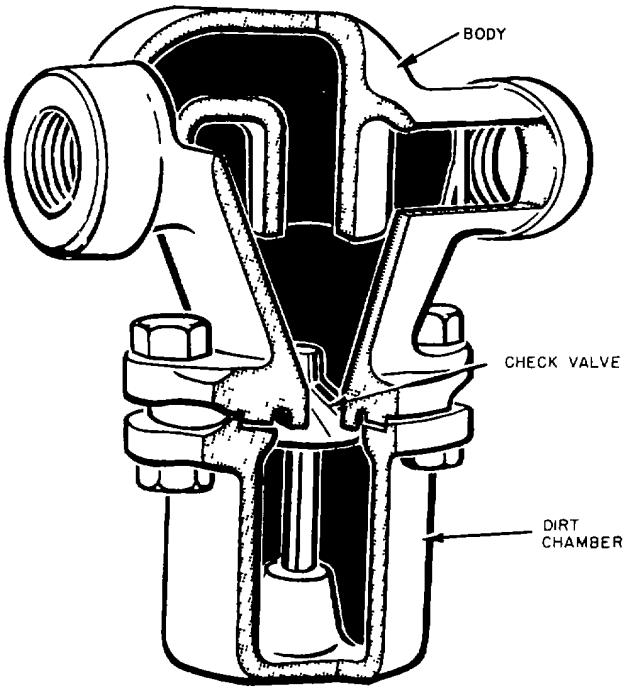


Figure 8-37. Centrifugal dirt collector.

(b) In high pressure position, handle 5 is turned to the position marked HP, 45 degrees below horizontal. The triple valve exhaust is through strainer 25, chamber *A,* past low pressure valve 4, through intermediate choke b, past high pressure *4a,* through final choke t, passage s, drilled port x in cock key 6, and past wasp excluder 22 to atmosphere. The pressure retaining valve of each valve is 10 pounds, and since the

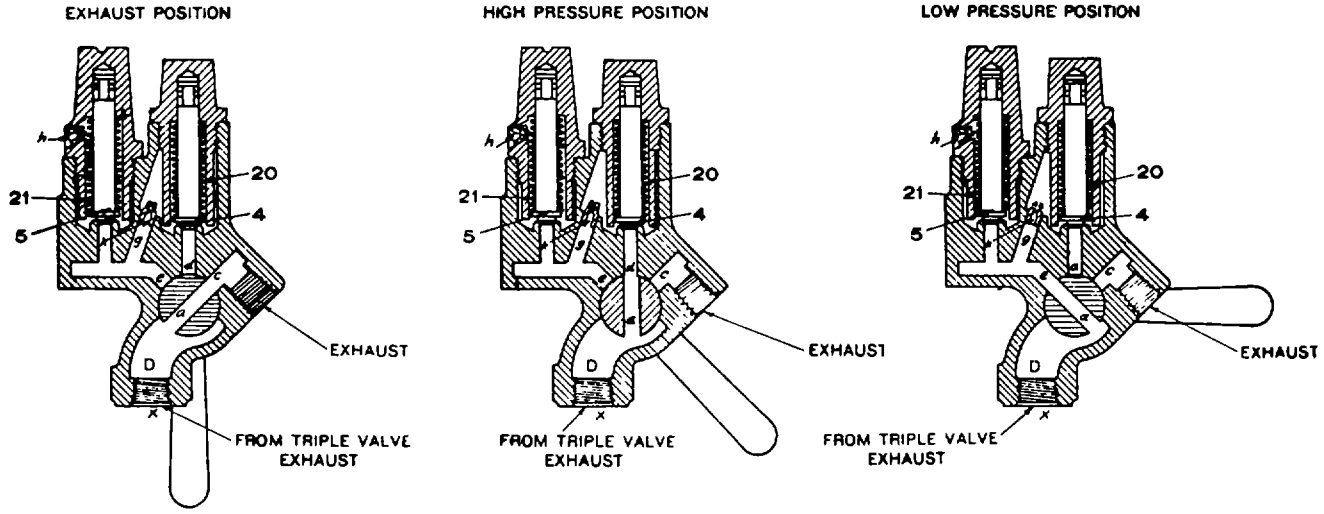


Figure 8-38. Diagrammatic views of standard pressure retaining valve.

valves are in series, they will close and retain 20 pounds brake cylinder pressure. The blowdown time of the brake cylinder from 50 pounds to 20 through chokes *b* and t is approximately 90 seconds.

(c) In low pressure position, handle 5 is turned to the horizontal position marked LP. The triple valve exhaust is through strainer 25, chamber *A,* past low pressure valve 4, through choke *b,* chamber *D,* port g in cock key 6, and past wasp excluder 22 to atmosphere Valve 4 will close to retain 10 pounds pressure in the brake cylinder. The blowdown time of the cylinder from 50 pounds to 10 pounds through choke *b* is approximately 60 seconds.

(d) In slow -direct exhaust position, handle 5 is turned to the position marked SD, 45 degrees above horizontal. The triple valve exhaust is through choke a, port *g* in cock key 6, and past wasp excluder 22 to atmosphere. The blowdown time of the brake cylinder from 50 pounds to 10 pounds is approximately 86 seconds; however, brake cylinder exhaust continues until all pressure is vented.

i. Variable Release Valve

(1) *Valve.* Figure 8-41 illustrates the auxiliary reservoir release valve which is of the variable reduction type with a maximum rate of reduction that permits the rapid depletion of auxiliary reservoir pressure. This valve is installed horizontally, providing greater clearance than the vertical type valve; and the internal parts are accessible for repair or replacement without removing the complete device from the reservoir. In order to inspect the valve assembly and spring, it is only necessary to remove the valve stem nut.

(2) *Handle.* The handle is made in two parts which are pivoted to impart travel to the variable opening vent valve, thereby unseating the latter, permitting the air to discharge from the reservoir. The amount of travel of the variable opening vent valve determines the rate of blowdown. A light or short pull on the hand rod results in a slow rate of discharge of auxiliary reservoir air, whereas a heavier pull, moving the valve to its maximum open position, will cause auxiliary reservoir pressure to be exhausted from 70 pounds in approximately 3 seconds. This valve is operated in the same manner as the old, by hand rods from either side of the car, and being fitted with 1/2-inch pipe stud, is completely interchangeable with the old.

j. Angle Cock. Figures 8-30 and 8-45 illustrate the angle cock, one of which is installed at each end of the brake pipe as shown. The cock is open with the handle parallel to the pipe line, as illustrated, and closed with the handle crosswise or at right angles to the pipe line. The handle may be removed independent of the socket. After driving out the hinge pin, the handle may be easily removed by first depressing it and then sliding it forward to permit the web to clear the

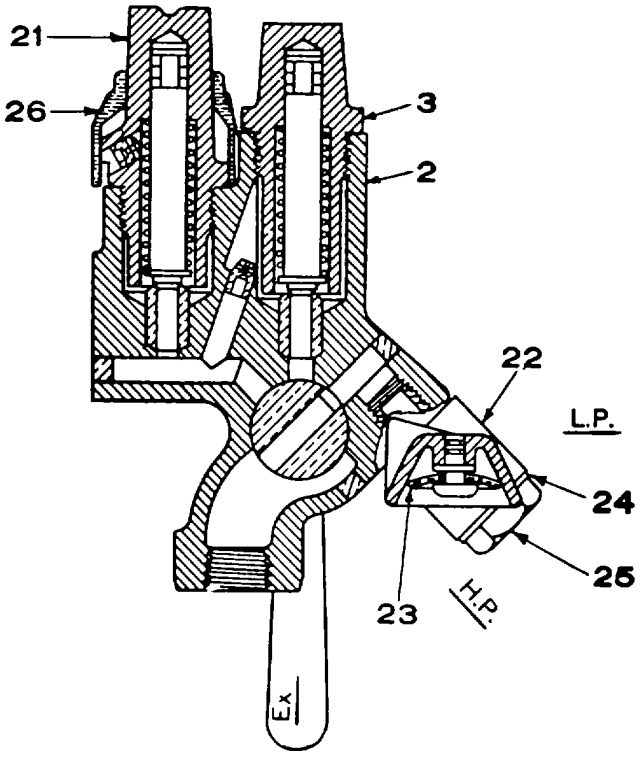


Figure 8-39. Sectional view of retaining valve with vent protector and improved wasp excluder.

socket lugs. The handle, of course, locks in both open and closed positions. When so locked, it is necessary to slightly raise the handle before it can be turned, thus insuring against accidental opening or closing by being stepped upon, flying missiles, or loose rods and chains. An extension with a U-bolt groove to the brake pipe end of the angle cock serves to support the brake pipe entering the angle cock while the groove in the extension permits the angle cock to be positively attached to the hanger bracket. The hinge portion has been strengthened and the size of the hinge pin increased to provide a larger bearing area. A split type socket is used and the rivet pinhole for locking the socket to the key is drilled through the split portion, engaging a notched out cavity in the square of the key. These changes provide greater strength and closer fit of the hinge portion, and a close and permanent fit between the 'handle socket and the cock key.

k Branch Pipe Tee. The purpose of the branch pipe tee (fig 8-42) is to prevent moisture that may be deposited in the brake pipe, from any cause, draining into the branch pipe connection and from thence into the triple valve. While the centrifugal dirt collector has proved very efficient in collecting moisture and dirt from the piping of the airbrake system, thereby protecting the triple valve, the use of the branch pipe tee will materially assist in preventing the excessive deposit of moisture in the branch pipe sometimes occasioned in charging and testing drains from poorly designed yard plants, or because the locomotive has insufficient reservoir capacity or cooling pipe to insure precipitation of the water before passing to the brake system. This fitting has the interior coring so designed that the outlet from the brake pipe to the branch pipe is at the top. Thus, as air enters at K from the brake pipe it flows upward into chamber *L* and thence through the pipe opening at the bottom to the branch pipe, the moisture and heavy particles of dirt passing on through the brake pipe.

l. Cutout Cock. The cutout cock, figure 8-43, of which there is one, 1 1/4-inch size in the branch pipe, should be placed where it can easily be reached but protected from accidental closing. This cock, when closed, cuts off communication between the brake pipe and the triple valve. The handle should be in such a position that, as affected by vibration, it would tend to jar open instead of shut.

m. Hose Connections. These (fig 8-44) make the brake pipe continuous throughout the train. When cars are being separated, as in switching, the angle cocks should be closed and the hose should be uncoupled by hand, to prevent rupture or damage. Failure to uncouple by hand causes shifting and breaking of the brake pipe as well as damage to the coupling gasket and hose.

8-23. Operation of Equipment

a. General. As it is impossible to show all the ports and connecting passageways in the graduating valve, slide valve, and seat by any single section taken through the triple valve, figures 8-45 through 8-50 illustrate in a purely diagrammatic way the relations of the various parts to each other, for the different positions of the triple valve piston. The actual proportions and mechanical construction of the parts have been disregarded where necessary to make the connections 'and operation more easily understood.

b. Full Release and Charging Position. As shown in figure 8-45, air from the brake pipe enters the triple valve through passages a and *e,* cylinder cap ports *f* and *g* to chamber H on the face of the triple valve piston; thence through feed groove *i,* now open to chamber *R* above the slide valve, which is always in free communication with the auxiliary reservoir. Air flows from

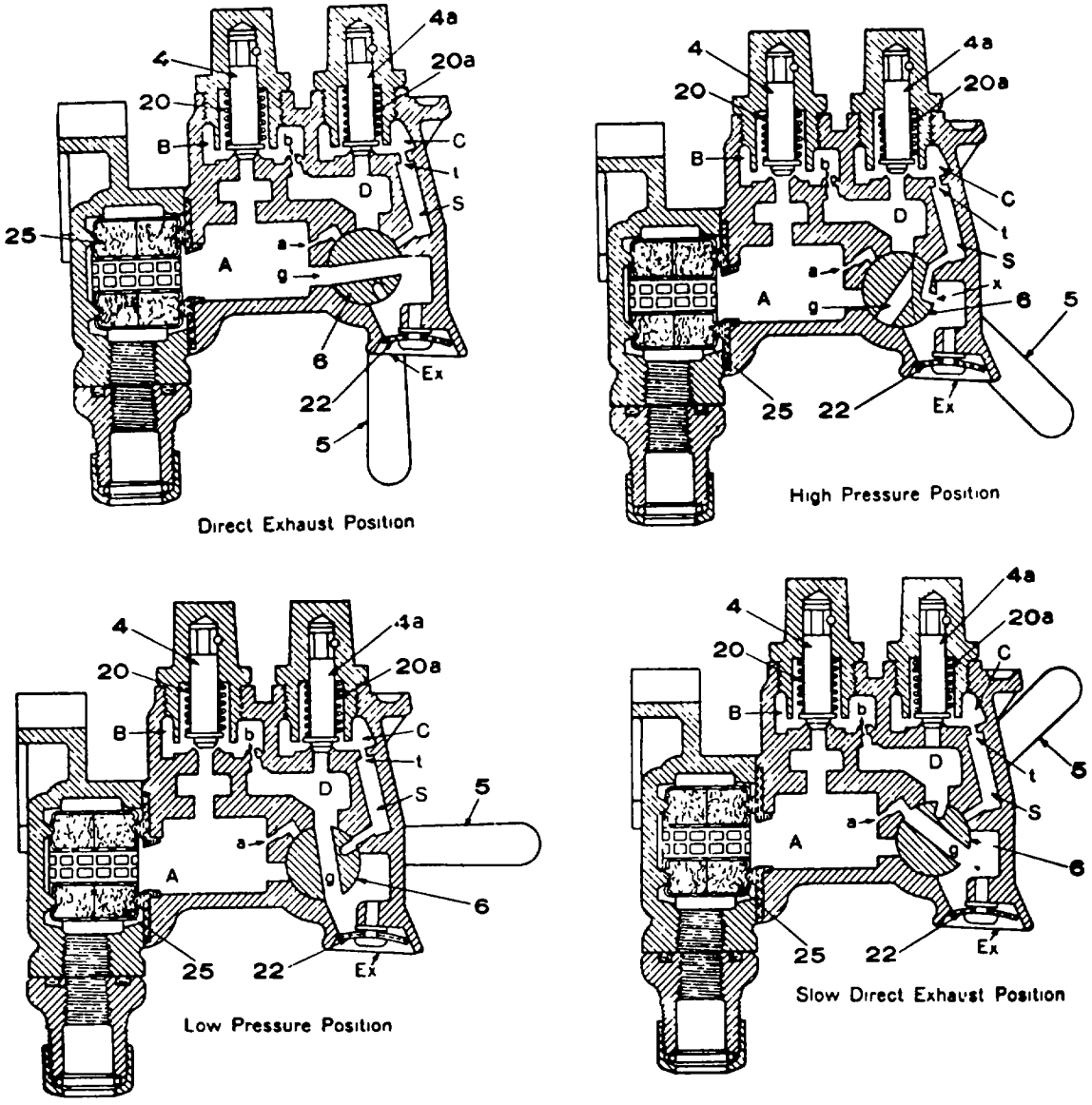


Figure 8-40. Diagrammatic views of four-position release control retainer.

the brake pipe to the auxiliary reservoir, as described, until their pressures become equal, when the latter is then, fully charged.

c. Quick-Service Position

(1) *First action.* A quick service application of the brake is obtained by making a gradual reduction in brake pipe pressure. As soon as the pressure in chamber H has been sufficiently reduced below that in chamber *R* on the other side of the triple valve piston, the higher pressure on the auxiliary reservoir side of the piston is able to overcome the friction of the piston 4 and its attached graduating valve 7 and move these parts to the left until the shoulder on the end of the piston stem strikes against the right-hand end of the slide valve 3. The latter is then moved to the left until the piston strikes the graduating stem 21, which is held in place by the compression of graduating spring 22. The parts of the valve are then in the position shown in figure 8-46. The first movement of the piston 4 closes the feed groove i, preventing air from feeding back into the brake pipe from the auxiliary reservoir, and at the same time the graduating valve opens the

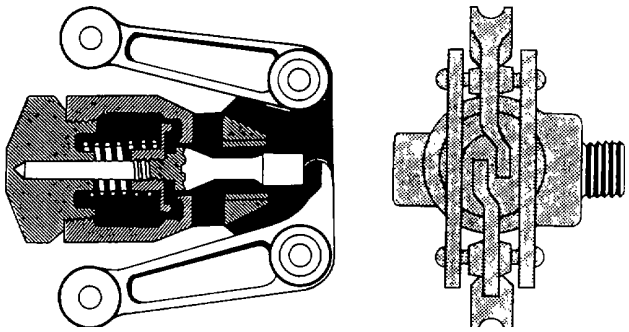


Figure 8-41. The auxiliary reservoir variable release valve.

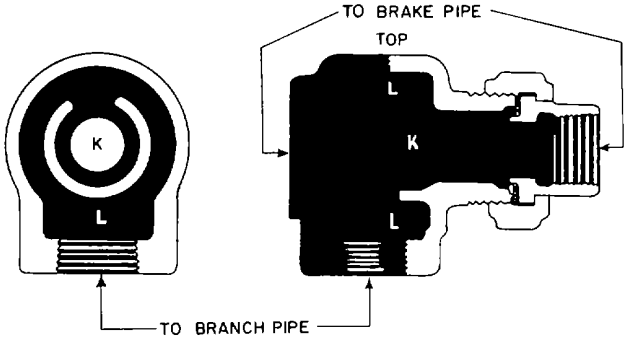


Figure 8-42. Branch pipe tee.

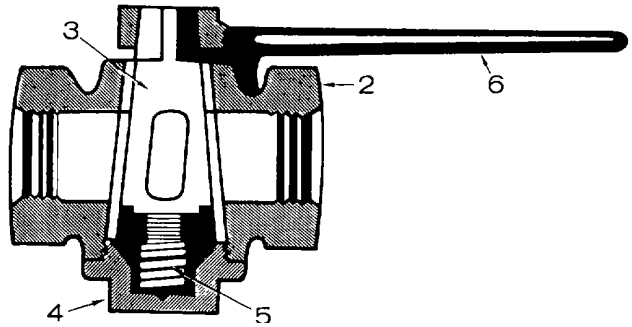


Figure 8-43. Sectional view of cutout cock

Figure 8-44. Hose connection

(2) *Secondary action.* At the same time, the first movement of the graduating valve connects the two ports o and q in the slide valve through the cavity v in the graduating valve, and the movement of the slide valve brings port o to register with port y in the slide valve seat, and port q with port *t.* Consequently, the air in chamber Y flows through ports *y, o, v,* q and *t,* thence around the emergency piston 8, which fits loosely in its cylinder, to chamber X and the brake cylinder. When the pressure in chamber Y has reduced below the brake pipe pressure remaining in a, the check valve 15 is raised and allows brake pipe air to flow past the check valve and through the ports mentioned above to the brake cylinders. The size of these ports is so proportioned that the flow of air from the brake pipe to the top of emergency piston 8, is not sufficient to force the latter downward and thus cause an emergency application, but at the same time enough air is taken from the brake pipe to cause a definite local reduction in brake pipe pressure at that point, which is transmitted in like manner to the next ,triple valve and, in turn, to the next, thus increasing the rapidity with which the brake pipe reduction travels through the train.

d. Full-Service Position. With short trains, the brake pipe volume being comparatively small, the pressure will reduce more rapidly for a certain reduction at the brake valve than with long trains. Under such circumstances, it might be expected that the added reduction at each triple valve by the quick-service feature would bring about so rapid a brake pipe reduction as to cause quick action and an emergency application, when only a light application was intended. (The emergency application is explained later.) But this is automatically prevented by the triple valve itself.

From figure 8-46 it will be noted that in the quick-service position, port z in the slide valve and port *r* in the seat do not fully register. Nevertheless, the opening is sufficient to allow the air to flow from the auxiliary reservoir to the brake cylinder with sufficient rapidity to reduce the pressure in the auxiliary reservoir as fast as the pressure is reducing in the brake pipe, when the train is of considerable length. If the brake pipe reduction is more rapid than that of the auxiliary reservoir, which may be the case on short trains, the difference in pressure on the two sides of piston 4 soon becomes sufficient to slightly compress the graduating spring, and move the slide valve

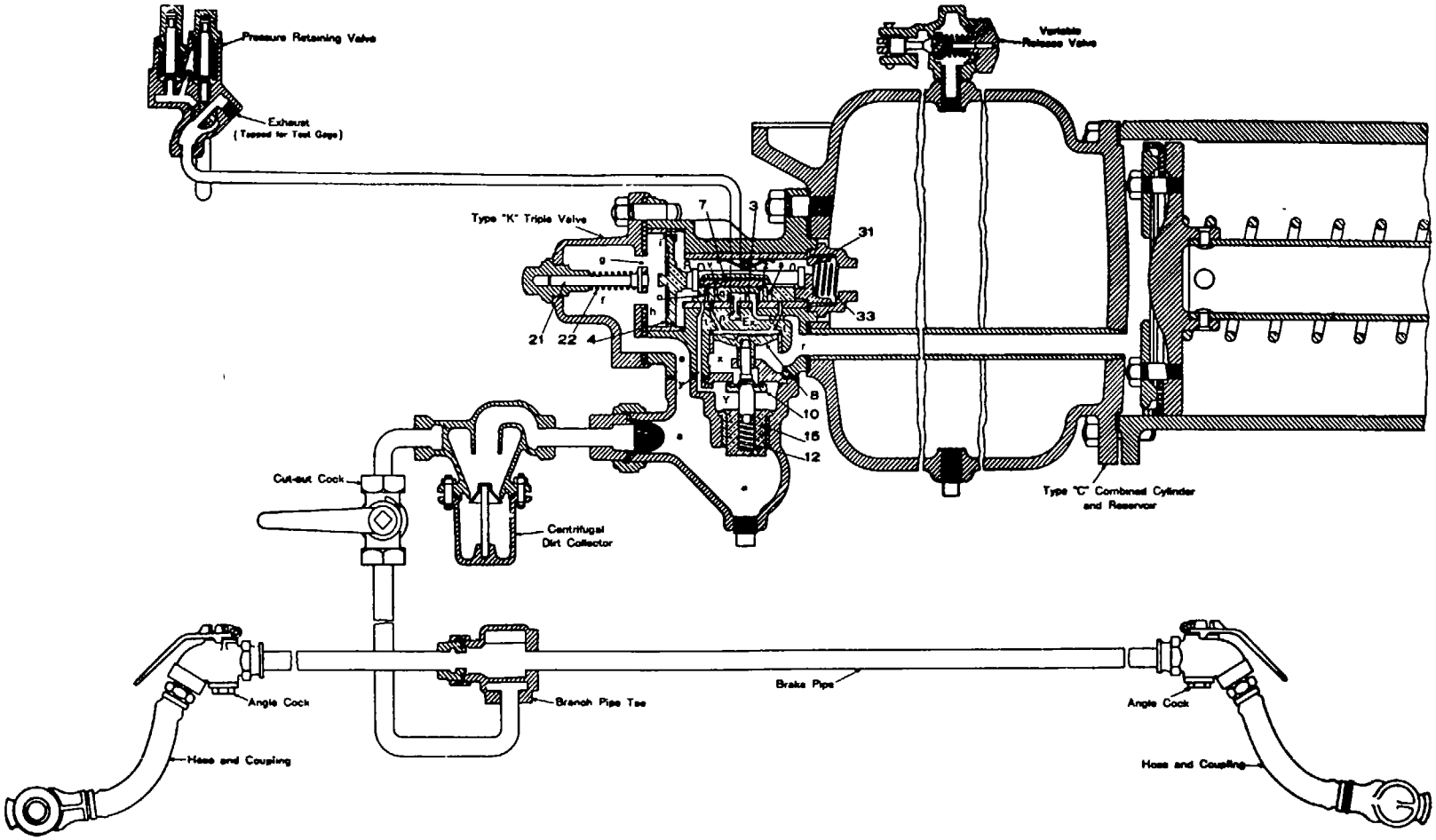


Figure 8-45. Release and charging position.

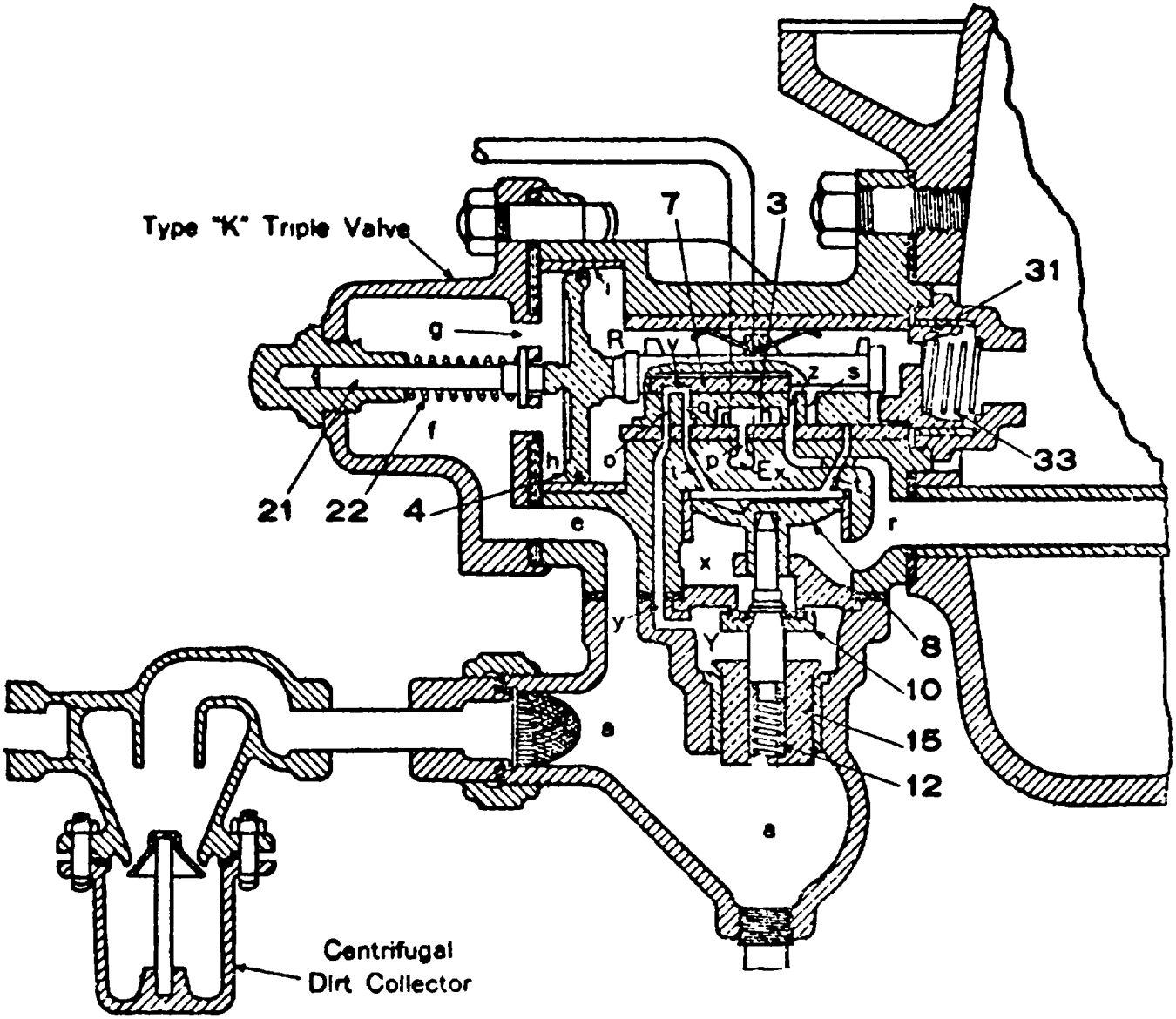
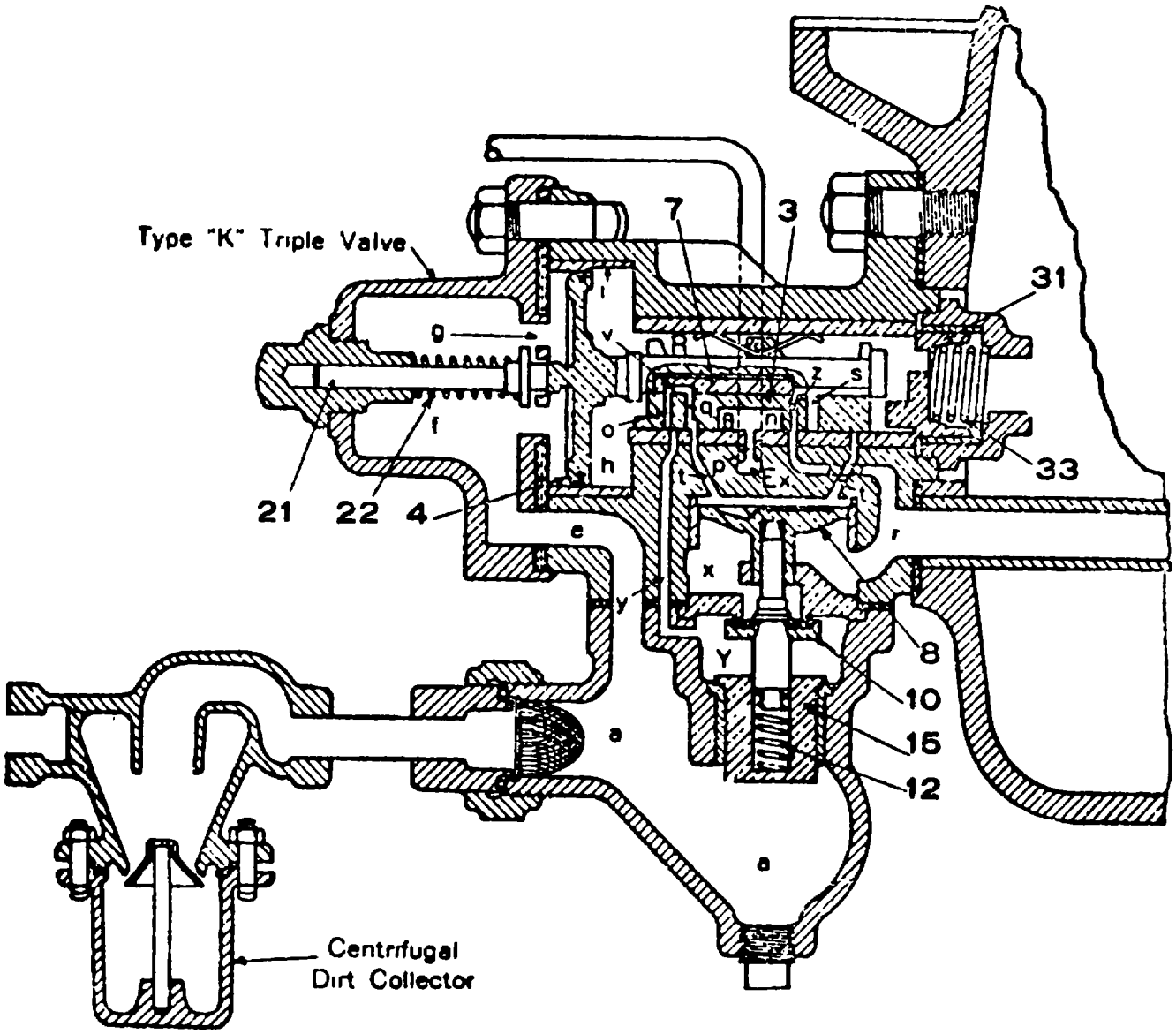


Figure 8-46. Quick service position.

to the position shown in figure 8-47, called *Full Service.* In this position, quick-service port y is closed, so that no air flows from the brake pipe to the brake cylinder. Thus, when the brake pipe reduction is sufficiently rapid, there is no need for the additional quick-service reduction, and the triple valve automatically cuts out this feature of the valve when it is not required. Also, in full-service position ports z and *r* are fully open, allowing the auxiliary reservoir pressure to reduce more rapidly, so as to keep pace with the more rapid brake pipe reduction.

e. Lap Position. When the brake pipe reduction ceases, air continues to flow from the auxiliary reservoir through ports z and *r* to the brake cylinder, until the pressure in the chamber R becomes enough less than that of the brake pipe to cause piston 4 and graduating valve 7 to move to the right until the shoulder on the piston stem strikes the left-hand end of slide valve 3. As the friction of piston and graduating valve is much less than that of the slide valve, the difference in pressure which will move the piston and graduating valve, will not be sufficient to move all three; consequently, the piston stops in the position shown in figure 8-48. This movement has caused the graduating valve to close z, thus cutting off any further flow of air from the auxiliary reservoir to the brake cylinder and also port o, thus preventing further flow of air from the brake pipe through the quick-service ports Consequently, no further change in air pressures can occur, and this position is called *Lap,* because all ports



are *tape--that* is, closed. Figure 848 shows the parts in *quick-service lap* position. It will be seen that the exact position of the slide valve 3, in *lap* position depends upon whether its previous position was that of *quick-service,* figure 846, or *full service,* figure 8-47. If the former, the lap position assumed would be quick-service lap position, as shown in figure 8-48. If the slide valve had previously moved to full-service position, however, the lap position assumed would be *full-service lap* position, figure 8-47, but with the graduating valve moved back so as to blank ports z and *o* in the slide valve and with the shoulder on the piston stem in contact with the ,left-hand end of slide valve 3 as shown in figure 8-48. If it is desired to make a heavier application, a further reduction of the brake pipe pressure is made and the operation described above repeated until the auxiliary reservoir and brake cylinder pressure become equal, after which any further brake pipe reduction is only a waste of air. About 20 pounds brake pipe reduction will ,give this equalization, with 70 pounds brake pipe pressure and 8-inch piston travel.

f. Retarded Release and Charging Position

(1) *Auxiliary reset in pressure.* The K triple valve has two release positions, *full release* and *retarded release.* Which position its parts will move to When the train brakes are released depends upon how the brake pipe pressure is increased in relation to the auxiliary reservoir pres-

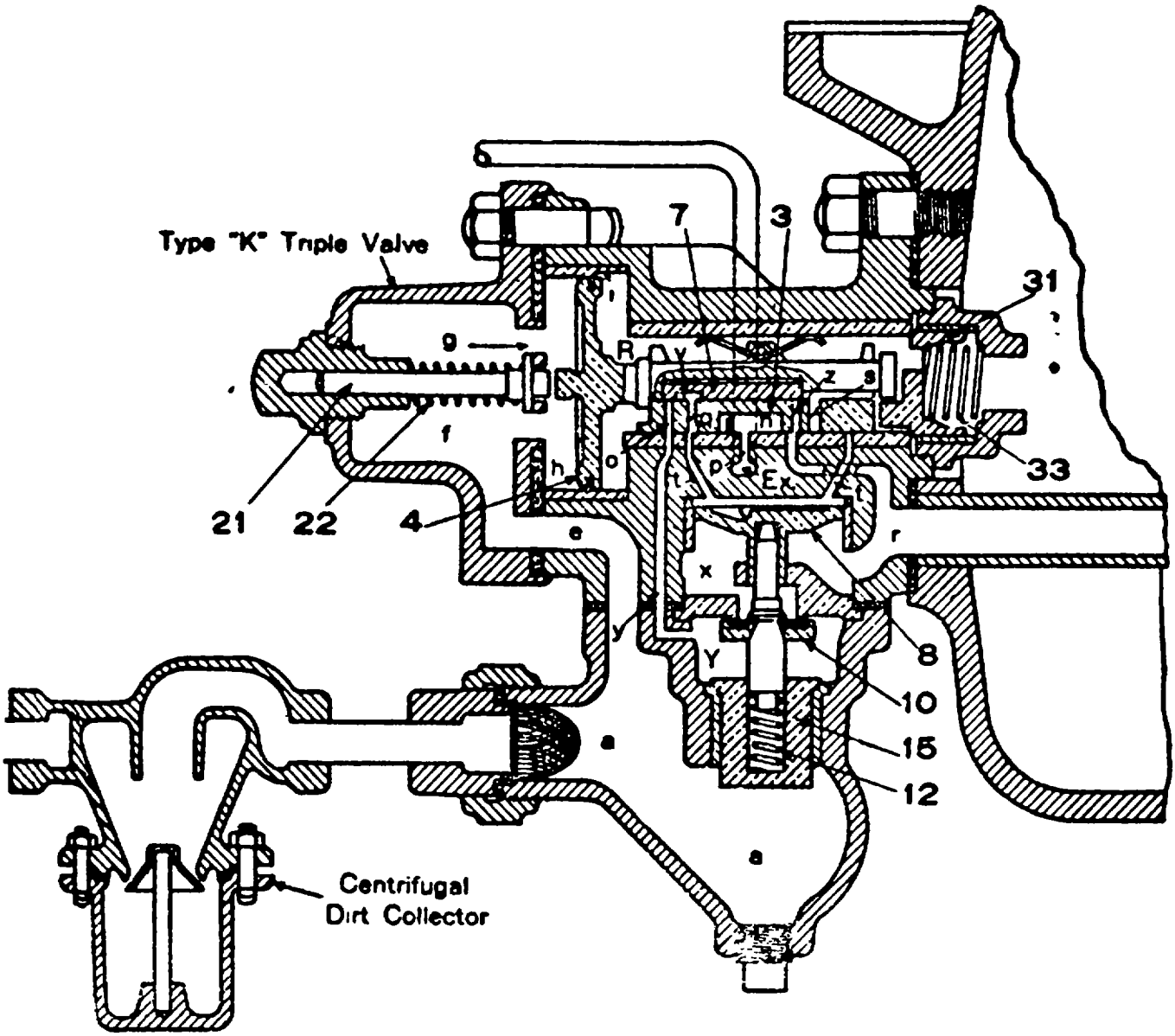


Figure 8-48. Quick-service lap position.

sure, as already explained. It is well known that in freight trains when the engineman releases the brakes, the rapidity with which the brake pipe pressure increases on any car depends on the posi(tion of the car in the train. Those cars toward the front, receiving the air first, will have their brake pipe pressure raised more rapidly than those in the rear. With the old standard apparatus, this is due to two things: the friction in the brake pipe; and the fact that the auxiliary reservoirs in the front begin to recharge, thus tending to reduce the pressure head by absorbing a quantity of air and holding back the flow from front to rear of the train. The *retarded-release feature* of the type K triple valve overcomes the second point mentioned, taking advantage of the first while doing so. The friction of the brake pipe causes the pressure to build up more rapidly in chamber *H* of the triple valves toward the front end of the train than in those at the rear. As soon as the pressure is enough greater than the auxiliary reservoir pressure remaining in chamber R after the application as above described, to overcome the friction of piston, graduating valve, and slide valve, all three are moved toward the right until the piston stem strikes the retarding stem 31. The latter is held in position by the retarding spring 33. If the rate of increase of the brake pipe pressure is small as, for example, when the car is near the rear of the train, it will be impossible to raise the pressure in chamber *H* 3 pounds higher than that in the auxiliary reser-

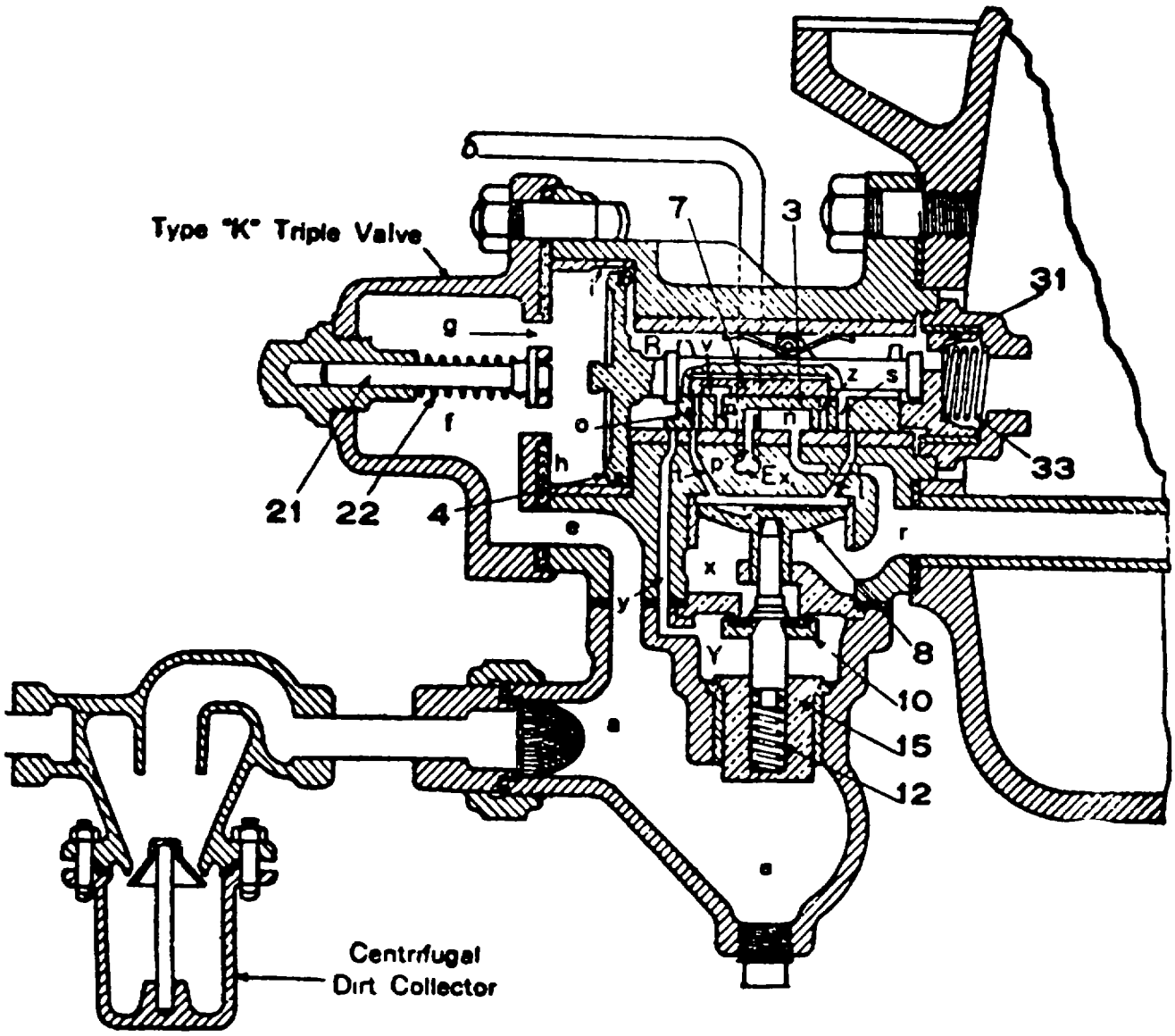


Figure 8-49. Retarded release and recharging positions.

voir on account of the flow of air from chamber H through feed groove i into the auxiliary reservoir, which is going on at the same time, the triple valve parts will remain in this position, as shown in figure 8-45. Brake cylinder air is exhausted through port *r,* large cavity *n* in the slide valve, and port *p* leading to the atmosphere (or retaining valve). The auxiliary reservoirs recharge as described under "Full Release and Charging. " If, however, the triple valve is near the head of the train, and the brake pipe pressure builds up more rapidly than the auxiliary reservoir can recharge, the necessary excess of pressure in chamber *H* over that in the auxiliary reservoir will be attained quickly, and will cause the piston to compress retarding spring 33, and move the triple valve parts to the position shown in figure 8-49.

(2) Retarded *release.* exhaust cavity *n* in the slide valve now connects port *r* leading to the brake cylinder with port p to the atmosphere, and the brake will release; but as the small "tail port" extension of cavity *n* is over exhaust port *p,* the discharge of air from the brake cylinder to the atmosphere is quite slow. In this way, the brakes on the front end of the train require a longer time to release than those on the rear. This feature is called the "retarded release," and although the triple valves near the locomotive commence to release before those in the rear, yet the exhaust of air from the brake cylinder in retarded release position is sufficiently slow to hold back the release of the brakes at the front end of the train long enough to insure a practically simultaneous release of the brakes on the train as a whole. This permits releasing the brakes on

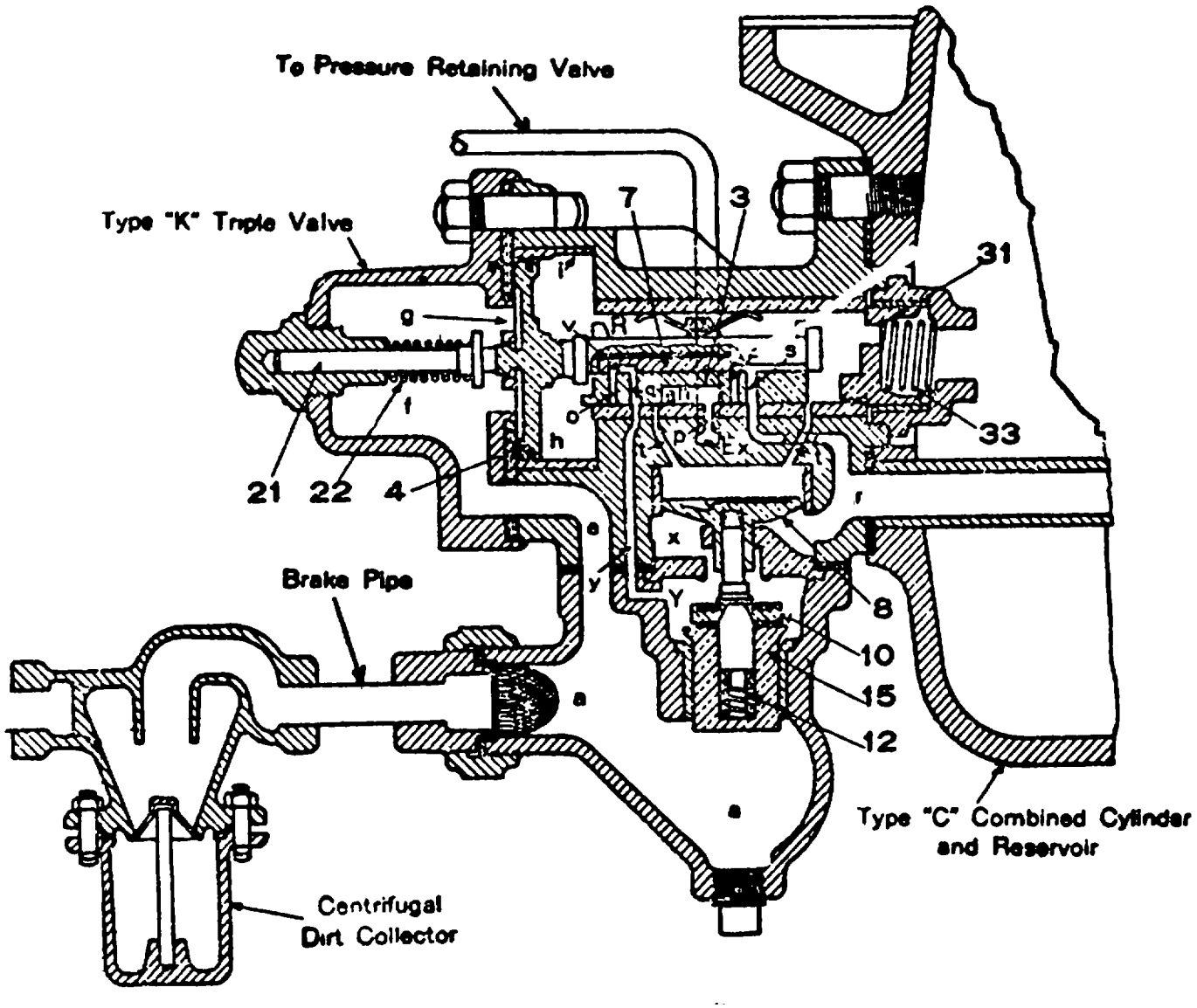


Figure 8-50. Emergency position.

very long trains at lower speeds without danger of a severe shock or break-in-two than is possible without this feature.

(3) *Triple valve piston feed groove.* At the same time, the back of the triple piston is in contact with the end of the slide valve bush, and, as these two surfaces are ground to an accurate fit, the piston makes a tight "seal" on the end of the bush except at one point where a feed groove (not shown in the dlagrammatics) is cut in the piston to allow air to pass around the end of the slide valve bush into chamber *R* and the auxiliary reservoir. This feed groove is much smaller than the standard feed groove t in the piston bush, so that when the triple valve piston is in *retarded release* position, the recharge of the auxiliary reservoir takes place much more slowly than when it is in *full-release* position. This piston seats firmly against the gasket, as shown

feed groove is larger in the K-2 than In the K-1 triple valve so as to maintain the proper rate of recharge to their respective auxiliary reservoirs in *retarded release* position.

g. Emergency Position. Quick action is caused by a sudden and considerable reduction in brake pipe pressure below that in the auxiliary reservoir, no matter how caused. This fall in brake pipe pressure causes the differences in pressure on the two sides of piston 4 to increase very rapidly, so that by the time the piston has traveled to its *full-service* position, as already explained, there is a sufficiently higher pressure on the auxiliary reservoir side of the triple *valve* piston to cause it to compress the graduating spring 22, forcing back the stem and spring until the

in figure 8-50. The resulting movement of the slide valve opens port t In the slide valve seat and allows air from the auxiliary reservoir to flow to the top of emergency piston 8, forcing the latter downward and opening emergency valve 10.

The pressure in chamber Y being thereby instantly relieved, allows brake pipe air to raise the check valve 15 and flow rapidly through the chambers Y and X to the brake cylinder, until brake cylinder and brake pipe pressures nearly equalize, when the valve is forced to its seat by the check valve spring, preventing the pressure in the cylinders from escaping back into the brake pipe again. The emergency valve, being held open by the emergency piston, will consequently return to its seat when the auxiliary reservoir and brake cylinder pressure have nearly equalized. At the same time, port s in the slide valve registers with port *r* in the slide valve seat and allows air from the auxiliary reservoir to flow to the brake cylinder. But the size of ports s and *r* is such that comparatively little air gets through them before the brake pipe has stopped venting air into the brake cylinder. This sudden discharge of brake pipe air into the brake cylinder has the same effect on the next triple valve as would be caused by a similar discharge of brake pipe air to the atmosphere. In this way ,each triple valve causes the next to assume emergency position, thus giving a quick and full application of all brakes.

The release after an emergency is effected in exactly the same manner as after a service application, but requires longer time, owing to the high brake cylinder and auxiliary pressures and lower brake pipe pressures.

8-24. Maintenance

a. General. The movable parts of the triple valve should never be removed while it is on the car. If the valve is not working properly or needs cleaning and oiling, take it down and replace it by a valve in good condition. All cleaning and oiling should be done at a bench, by a competent mechanic, where the liability of damage to the internal parts of the valve is least. Any attempt to take the triple valve apart while still on the car is almost sure to result in a large percentage of valves being injured by careless handling or dirt getting inside the pipes or valve. If repairs are necessary, such triple valves should be returned to the shops for that purpose.

b. Retaining Valve. The retaining valve should stand vertically; there should be no obstruction to the removal of the caps; it should be so located as to be freely accessible when the train is in motion. It should be cleaned, but not oiled, every time the remainder of the airbrake equipment receives that attention; both it and the connecting pipe should be well secured; and a little flexibility should be provided in the pipe leading to it from the triple valve. The wasp excluder (if used) should be removed from the retaining valve during the usual brake cleaning period and the retaining valve pipe blown out, after which the wasp excluder should be replaced in the retaining valve.

c. Brake Cylinder Lubrication.

(1) *Disassembly.* Close the branch pipe cutout cock and drain the auxiliary reservoir. Fasten the hollow piston rod and nonpressure head together with a cotter pin through the hole provided in the hollow rod or with a suitable clamp. Remove -the nuts from nonpressure head bolts, then remove the piston from the cylinder.

(2) *Cleaning cylinders.* Scrape the old lubricant from the cylinder wall and leakage groove and wipe these surfaces clean and dry. Kerosene may be used for assisting in cylinder cleaning but should be completely removed to prevent damage to cylinder gaskets and packing cups. If the cylinder wall is rusted, the rust should be removed with sandpaper.

(3) *Cleaning piston and packing cup.* Remove expander ring (if used) from piston Scrape old lubricant from the metal part and packing cup, using a dull-edge round-end scraper (like a case knife), and wipe all surfaces clean and dry. The packing cup should be carefully examined and should be renewed if brittle, thin at any point, cut, cracked, or otherwise defective. Examine piston and follower plate for cracks and tighten up follower plate nuts.

(4) *Applying new packing cups.* Examine follower studs for tightness in the piston. Locate the packing cup centrally on the piston. Place the follower in position and apply the nuts, bringing them in contact with the follower without tightening. Then draw them down uniformly.

(5) *Application of lubricant.* Apply a coating of brake cylinder lubricant to the wall of the cylinder and to the outside of the packing cup with a brush.

(6) *Assembling.* The piston should be stood on end with the top edge or flat side of the nonpressure head flange and the opening of the expander ring (if used) toward the workman. With the piston In this position, enter it into the cylinder. The sleeve or rod should then be slowly raised and the piston moved into the cylinder until the upper portion of the packing cup engages

the cylinder wall. Form this portion into the cylinder while the sleeve or rod is being gradually raised, taking special care not to crimp or otherwise damage the packing cup Then pull upward and outward on the sleeve or rod until it is in horizontal position. Push the piston to its release position and then raise the sleeve or rod to the top of the cylinder to determine whether the expander (if used) is in its proper position, which will be indicated by freedom of movement.

d. Triple Valve Lubrication

(1) *Cleaning.* Under ordinary service conditions, the triple valve should be thoroughly cleaned and lubricated every 15 months. The proper interval is best determined for each particular case by a careful inspection and trial. Where conditions are severe and the triple valve exposed to extremes of weather, dirt, etc, more frequent inspections will, no doubt, be found necessary. Where the valve is protected and not subjected to hard usage,-the interval may be lengthened. The piston, slide valve, graduating valve, and bushings must be thoroughly cleaned so as to remove all dirt, oil, gum, or grease. Benzine, gasoline, or other approved cleaning fluid can be used for this purpose. The piston packing ring and its groove should be cleaned without removing the ring from the piston groove. This can be done by dipping the piston in the cleaning fluid and then moving the ring around in the groove. This operation should be repeated until the groove and ring are thoroughly cleaned, after which the excess cleaning fluid can be blown away or dried by using an air jet.

(2) *Loosening rings.* Where rings are stuck with dirt too tightly to be moved in the groove, it may be necessary to soak the ring in penetrating oil and then tap the ring gently with a hard block. For this purpose, a maple or hickory wooden block about 1 by 1 by 4 inches (with square ends) should be used to tap the ring so as to drive it flush with the top edge of the groove. This tapping should start at one side of the ring joint and progress around the piston in short steps until the ring is loosened sufficiently to be moved in the groove. If this procedure will not loosen the ring, it is evident that the groove is binding, in which case, the groove must be -coniditioned and a new ring fitted.

(3) *Glazing valves.* The face of the graduating valve, the upper surface of the slide valve (which is the graduating valve seat), the slide valve face, the slide valve seat, and the upper portion of the bushing (slide valve spring bearing) must be glazed with the best grade of very fine, pure, dry airbrake graphite. To apply the graphite, it will be found convenient to use a small wooden paddle about 8 inches long having a small piece of chamois skin glued to the paddle end. The width of this paddle must be somewhat less than the width of the slide valve seat in the bushing. Place a small quantity of the graphite on the chamois skin and rub the surfaces specified until they show a dark copper color. There must be no free graphite allowed to remain on the valves or seats and they must be free from any oil or grease before the graphite is applied.

(4) *Oiling piston* Before the cleaned piston is replaced in the piston bushing, press the side of the packing ring opposite the scarf to the bottom of its groove, then introduce three drops of approved triple valve oil in the groove through the ring scarf opening, after which restore the ring to its normal position and carefully rotate it in its groove to distribute the oil. Position the ring scarf approximately 1 inch either side of the piston top center Next, place three drops of the triple valve oil in the clean, dry bushing and distribute it over the entire surface in a manner to avoid introducing dirt or other grit. Then insert the piston and slide valve in the body, leaving them in release position, after which place three additional drops of tripe valve oil in the cylinder bushing and again distribute it on the bushing surface as previously described. No lubricant should be used on the quick action parts.

8-25. General Information for Carmen and Trainmen

a. Releasing Brakes. In releasing an individual brake by means of the release valve on the auxiliary reservoir, the brake pipe being charged, the release valve should be held open only until the exhaust is heard to start. In this way, if the auxiliary reservoir pressure is reduced much below that ,in the brake pipe, the piston will go to retarded release position and the release will be slower. Where there is no air in the brake pipe, the brake must be released by holding the release valve open until all the air has escaped. When it is found necessary to cut out the brake, close the cutout cock in the brake pipe branch pipe and bleed the auxiliary reservoir.

b. Road Troubles

(1) *Common defects.* The most serious defects that might cause trouble on the road are leaky slide valve, leaky check valve case gasket, leaky triple valve body gasket, leaky emergency

valve, leaky main piston packing ring, leaky auxiliary reservoir tube, and broken graduating spring.

(2) *Air leaks*

(a) A blow from the triple valve exhaust indicates a leak either from the brake pipe or the auxiliary reservoir. To determine which, cut out the brake by closing the brake pipe branch pipe cutout cock. If the brake applies and the blow stops, it indicates a leak from the brake pipe If the blow continues and the brake does not apply, it indicates a leak from the auxiliary reservoir.

(b) An auxiliary reservoir blow is caused by a leaky slide valve, triple valve body gasket, or the auxiliary reservoir tube. A leaky slide valve usually will cause a blow when the triple valve is in either release or application position, while a leaky body gasket or auxiliary reservoir tube will cause a blow only when the triple valve is in release position.

(c) A brake pipe blow is caused either by a leak by the emergency valve or the check valve case gasket.

(d) A leaky main piston packing ring may prevent the brake from applying on a light reduction on a long train or if applied it may prevent a proper release.

(3) *Broken springs*

(a) A broken graduating spring may cause undesired quick action depending upon the condition of the triple valve and the rate of brake pipe reduction. If the triple valve is dry and gummy or the brake pipe is reduced at too rapid a rate through leakage or otherwise, quick action is almost sure to result.

(b) A broken retarding spring permits the triple valve piston to move to retarded release position, causing a slow release of the brake.

c. Valve Buzzing. A type K triple valve in good condition will not continuously buzz. A continuously buzzing valve indicates that the emergency valve is leaking, in which case there will be a blow at the triple valve exhaust. This may sometimes be remedied by jarring the triple valve lightly near the emergency valve. Should this not stop the blow, apply the brake in emergency by parting the hose and opening the angle cock quickly; then release the brake by connecting up the hose and repeat the operation, if necessary. This may dislodge the dirt and allow the valve to seat properly. If the valve cannot be forced to its seat, the defect should be reported for correction.

Section VI. SPECIAL-PURPOSE EQUIPMENT

8-26. Air Strainer and Wasp Excluder

a. General. The 3/8-inch OB-1 strainer with choke and for foreign service and other special-purpose cars. It is connected with the triple valve exhaust by a short pipe nipple and takes the place of the pressure retaining valve and pipe described in paragraph 8-21g. The purpose of the device is to choke the brake cylinder exhaust and provide for a longer release time after a release has been started. This device, however, exhausts all the air pressure at the reduced rate. The strainer curled hair cleans the air and protects the choke from being clogged. A wasp excluder located in the strainer opening to the atmosphere insures a clear passage.

b. Components. The 3/8-inch OB-1 air strainer with choke and wasp excluder consists of a strainer body tapped for a 3/8-inch pipe, perforated brass plate, curled hair which cleans the air, and a choke fitting which holds the choke and wasp excluder. The OB-1 strainer is connected to the triple valve exhaust pipe by a cap, thus the path of the exhaust air is through the cap, strainer hair, choke, and wasp excluder to the atmosphere. wasp excluder may be encountered on freight cars built

8-27. Combined Brake Cylinder and Auxiliary Reservoir

a. General. The auxiliary reservoir has a choke plug inserted in the tube leading to the brake cylinder. The purpose of the choke is to nullify the quick-action feature. In other respects, this reservoir and the brake cylinder are the same as those described elsewhere in this manual. Piston travel less than 7 inches or more than 9 inches must be adjusted to approximately 8 inches.

b. Operation. The operation of this equipment is the same as that described in paragraph 8-16 except when the brake pipe pressure is suddenly reduced to cause emergency quick action, as described in paragraph 8-23g (fig 8-50). The choke then controls the flow of brake pipe air to the brake cylinder. It, therefore, prevents quick action from being passed to adjoining equipment. Consequently, in a train of special-purpose equipment, the brake pipe reduction will not be at an emergency rate throughout the train on account

of the control of the flow of brake pipe air through the choke to the brake cylinder. Some equipment has been manufactured without the choke plug but with the auxiliary reservoir tapped for insertion of the plug later, if desired. Consequently, on such equipment, the quick action feature (para 8-20b) is operative.

8-28. Single-Car Testing Device

a Operation. The purpose of the single-car testing device (fig 8-51) is to provide a means for a general check on the condition of the brake equipment on "in-date" cars while in service and on cars which have undergone periodic repairs without the removal of any device from the car.

(1) There are two types of single-car testing devices which are similar in appearance. One is for passenger cars and the other for freight cars. The passenger device can be identified by a nameplate marked PASS, while the freight device is marked FRT. Freight device is now equipped with a flowrator to check flow of air through device.

(2) The single-car testing device arrangement must include a suitable feed valve or reducing valve in the supply line for the purpose of providing a constant pressure source as defined in the test codes and an efficient air filter in the supply line ahead of the feed valve.

(3) The use of a hose is optional between the testing device and the outlet hose coupling which connects to the brake pipe hose on the car. Outlet hose must be 3/4-inch diameter with 1/2inch connecting nipples and must not be more than 8 feet long.

(4) In the event of valve falling to pass the specified test, it should be ascertained that the single-car testing device is not at fault. If the device is not at fault, airbrakes must be cleaned.

(5) Care should be exercised in moving the test device handle back to position No. 3 (lap) after making brake pipe reductions of 15 pounds or more in position No. 5 When snapped back, the temperature effect will cause the brake pipe pressure to rise 1 1/2 to 2 pounds and may be the cause of an undesired release. The device handle should be moved slowly toward lap position.

(6) When making tests of cars having two sets of brake equipment, each set must be tested separately, with the branch pipe cutout cock closed to one set while the other set is being tested. A complete test (including brake pipe leakage on passenger cars) must, however, be made with each set of equipment unless the passenger single-car testing device with flowrator is used. If both sets are connected to use one common brake cylinder release valve, it will also be necessary to blank off the 3/4-inch brake cylinder pipes at both the control valve and the brake cylinder on the set not being tested. This may readily be done by temporarily inserting 1/16 by 1 7/8-inch blanking plates between the flanged fittings and the bolting faces.

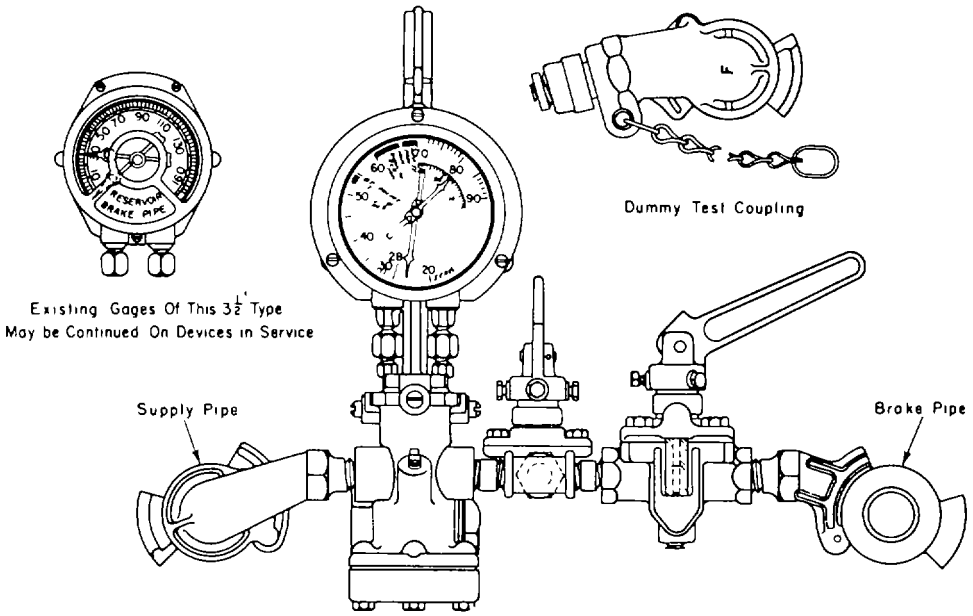


Figure 8-51. Freight single-car testing device with flowrator.

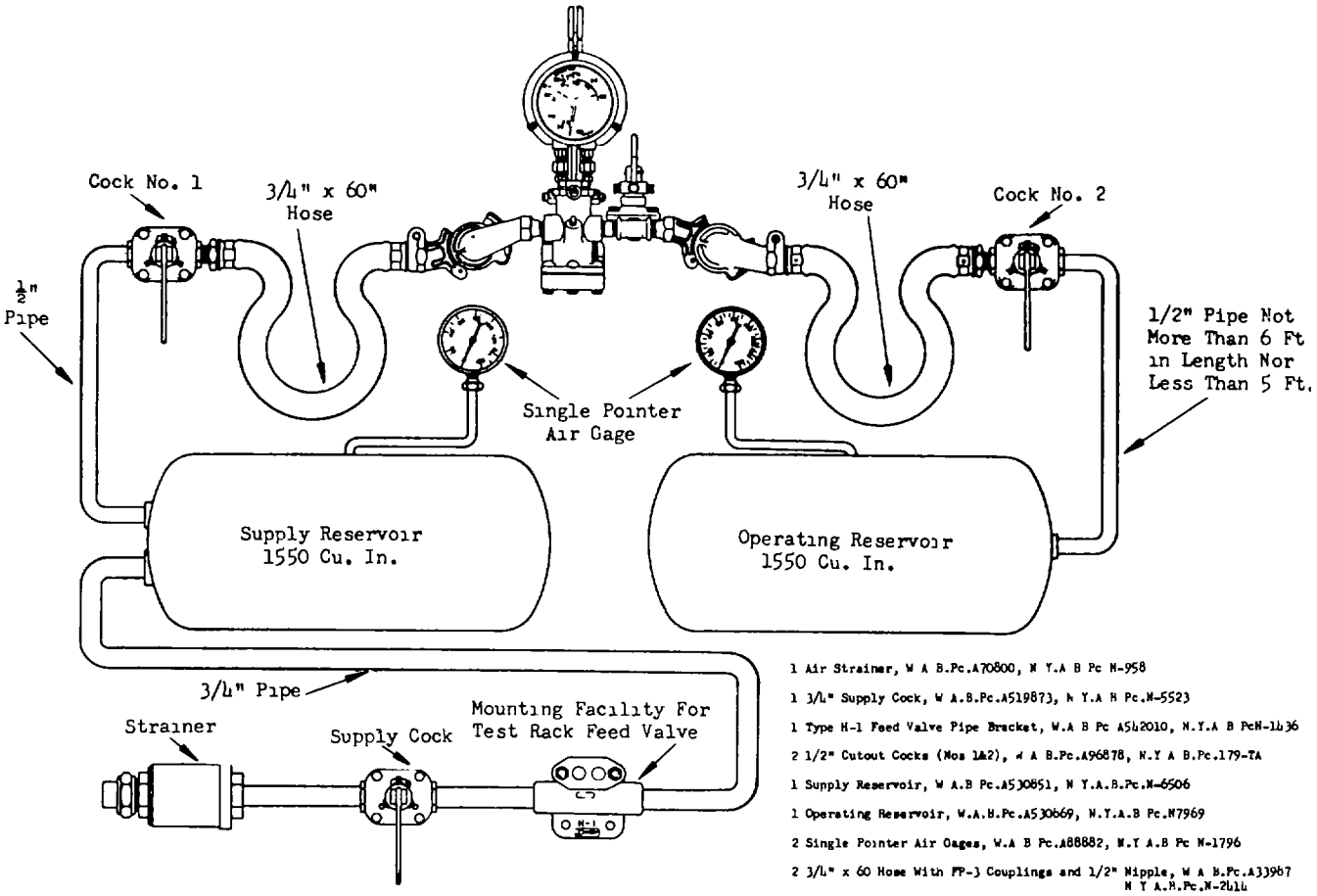

Cock No. 1
3/4" x 60" Hose
3/4" x 60" Hose
Cock No. 2
1/2" Pipe
1/2" Pipe Not More Than 6 Ft in Length Nor Less Than 5 Ft.
Single Pointer Air Gage
Supply Reservoir 1550 Cu. In.
Operating Reservoir 1550 Cu. In.
3/4" Pipe
Strainer
Supply Cock
Mounting Facility For Test Rack Feed Valve
1 Air Strainer, W A B.Pc.A70800, N Y.A B Pc N-958
1 3/4" Supply Cock, W A.B.Pc.A519873, N Y.A B Pc.N-5523
1 Type H-1 Feed Valve Pipe Bracket, W.A B Pc A542010, N.Y.A B PcN-1436
2 1/2" Cutout Cocks (Nos 1&2), W A B.Pc.A96878, N.Y A B.Pc.179-TA
1 Supply Reservoir, W A.B Pc.A530851, N Y.A.B.Pc.N-6506
1 Operating Reservoir, W.A.B.Pc.A530669, N.Y.A.B Pc.N7969
2 Single Pointer Air Gages, W.A B Pc.A88882, N.Y A.B Pc N-1796
2 3/4" x 60 Hose With FP-3 Couplings and 1/2" Nipple, W A B.Pc.A33967 N Y A.B.Pc.N-2444

Figure 8-52. Piping diagram of arrangement for testing the standard passenger single-car testing device.

(7) air signal equipment must be tested as provided in Westinghouse Instruction Leaflet No. 2377-2.

b. General Instructions for Testing and Maintaining the Freight Single-Car Testing Device

(1) To secure reliable and uniform results with the single-car testing device, it must be kept free from leakage and must be tested (fig 8-52) not less than once every 30 days and oftener if necessary. Any leakage must be corrected.

(2) As often as service conditions require, the rotary valve must be lubricated with a suitable diaphragm cock, it is necessary to apply only a small amount of suitable grease to the cam part of the handle where it contacts the actuating plunger.

(3) The test gage must be kept accurate and must be compared with a master gage as often as the device is tested.

(4) Step-by-step instructions on how to operate the test device, make various tests, and maintain the device are contained in WAB Instruction Pamphlet No. 5039-4, Supplement No. 1 (Single-Car Testing Device, Code of Tests).

Section VII. VACUUM AUTOMATIC AIRBRAKES

8-29. General

Vacuum brakes are extensively used in the South American republics, Africa, India, and Great Britain. Vacuum automatic brake equipment offers a very simple and efficient means of providing braking power for relatively light tonnage trains. In a vacuum brake system, the maximum available pressure for applying the brakes is less than that of the atmosphere. Consequently, much larger brake cylinders are necessary to provide the needed force than in the compressed airbrake system used in CONUS and some other parts of the world such as China, Korea, and Japan. Figure 8-53 illustrates the component parts of the conventional vacuum brake system.

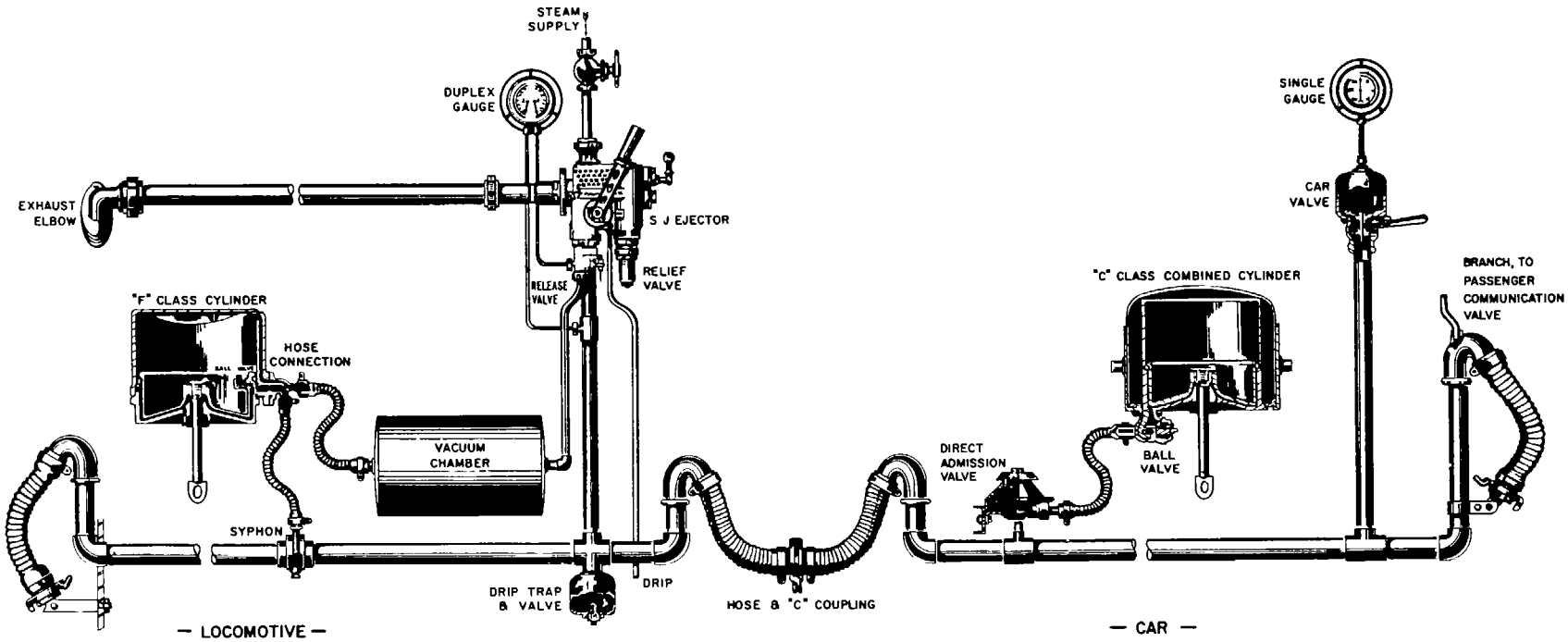


Figure 8-53. Vacuum brake system.

8-30. Operation-Steam Locomotives

a. The train pipe and vacuum chambers are carried at subatmospheric pressure during release and running operations. The pressure on both sides of the brake cylinder piston is thus equalized, and the braking force is removed from the brakeshoes. To apply the brakes, the vacuum in the trainline is reduced by admitting air from the atmosphere into the trainline. This inflow of air creates a difference in pressure across the brake cylinder piston resulting in a force which is transmitted through the brake rigging to the brakeshoes to apply the brakes.

b. A steam ejector on the locomotive uses steam at boiler pressure to create a vacuum in the vacuum reservoirs and the train pipe until such time as it is desired to apply the brakes. The vacuum reduction attachment of the steam ejector controls the amount of vacuum in the trainline to a constant maximum value irrespective of variations in steam pressure. Each brake cylinder is connected with one side of its piston open to the train-line and the other side open to a vacuum chamber which is evacuated to correspond to trainline conditions through a ball type check valve. To apply the brakes, it is only necessary to partially reduce the vacuum on the application side of the brake cylinder piston without disturbing it on the vacuum chamber side. This is done by admitting air from the atmosphere into the trainline. The maximum power is derived from the brake cylinder by maintaining the vacuum on the vacuum changer side of the piston and completely destroying the vacuum in the trainline.

c. The vacuum system is made up of two separate pipelines connected to the steam ejector. The first line is for the locomotive and tender only and connects the vacuum reservoirs and the chambers above the brake cylinder piston to the vacuum chamber connection of the steam ejector. The second line (the trainline) runs the entire length of the train and is made up of permanently fixed lines on each car, locomotive, and tender. The second line is coupled between the cars with a flexible hose and coupling. This line is connected to each car, and to all vacuum chambers through a ball valve. The ends of the trainline, both at the head of the locomotive and at the rear of the last car, are closed by placing the couplings on dummy coupling plugs. Atmospheric pressure forces the coupling gaskets to seal on the plugs, thereby effectively closing the ends of the system.

d. On heavy steam locomotives, it is customary to use live steam in the driver brake cylinders and vacuum brakes in the tender. The admission of steam to, and the exhausting of steam from, the steam brake cylinders is controlled by the engineman with the use of a steam brake attachment which is applied to the steam ejector.

8-31. Operation-Diesel-Electric Locomotives

a. General. Diesel-electric locomotives to be used in single or multiple (MU) service handling vacuum-braked trains may be equipped with the Westinghouse 28-LV-1 brake equipment, a combined compressed air and vacuum brake. Thus, on trains equipped with vacuum brakes, the locomotive brakes are operated by compressed air, either independently or in conjunction with the car brakes. In the latter case, the air system acts as a pilot for the train vacuum brakes.

b. Brake Application. When the locomotive and train brakes are applied, the automatic brake valve is moved into the service brake zone, permitting brake pipe air pressure to drop at the desired service rate. The reduction in brake pipe pressure operates a control valve to admit atmospheric air into the vacuum brake pipe. The destruction of vacuum in the vacuum brake pipe is in proportion to the air pressure brake pipe reduction made. The 28-V13 control valve responds to the loss of vacuum in the vacuum brake pipe to apply the locomotive brakes via the C-2 relay valve. Simultaneously, the vacuum car brakes are applied due to the destruction of vacuum via the VA-1-A control valve. On a vacuum-braked train after the desired air brake pipe reduction, the atmospheric air buildup in the VA-1-A control valve operates to cut off the flow of atmospheric air to the vacuum brake pipe. Thus, the control valve is lapped, holding the vacuum brakes applied. The VA-1-A control valve will automatically maintain the desired degree of brake application against normal vacuum brake pipe leakage. Complete details of the operation of this equipment are contained in the manufacturer's instruction pamphlets.

CHAPTER 9

CAR SUPERSTRUCTURE

Section I. PASSENGER CARS

9-1. General

a. Superstructure Assembly. Car superstructure has been generally defined in paragraph 3-9 as everything installed above the car floor. Passenger type car bodies are constructed of plates or sheets of steel or some other metal of equivalent strength. Many modern passenger cars have aluminum superstructure or bodies Both the inner and outer finish sheets are riveted, bolted, or welded to a steel skeleton framework, which in turn is secured to the car underframe.

b. Heating, Lighting and Ventilation. Modern passenger car equipment has one or more of the following systems: heating, lighting, pressure or gravity water supply, and air conditioning. Equipment for heating, lighting, and ventilation will be installed on Army-owned passenger cars only when specified by the procuring agency.

c. Specifications for CONUS-Type Cars. The Railway Mall Service Specifications for 1938 were used as the basis for accepted specifications for cars which may be used in domestic trains of over 600,000 pounds lightweight. Trucks are required to be locked to the car body. A car structure is required which resists a static end load of 800,000 pounds applied to the centerline of draft without developing any permanent deformation in any member of the car structure. In meeting this requirement, it is important that vertical deflection be kept to a minimum. Normal vertical deflections of cars having approximately a 60-foot distance between truck centers range from 1/2 to 3/4 inch for steel construction. Cars must be designed to resist a horizontal load of 500,000 pounds applied on the buffer beam at a point 12 inches above the centerline of draft. The buffer beam construction, and anticlimbing arrangement, and the coupler-carrier arrangement are designed to resist vertical loads of 100,000 pounds. These requirements enable coupled car ends moving vertically with respect to each other to resist abnormal impact. The two main vertical end members are required to have an ultimate shear value of not less than 300,000 pounds each at a point even with the top of the underframe to which they are attached.

9-2. Guard Cars

The standard gage domestic service railway guard car (fig. 2-8), somewhat similar to a caboose, is designed to transport Army security personnel when accompanying classified shipments over commercial railroads within CONUS. It is mounted on two four-wheel trucks that have coil spring suspension. Seven of these cars are equipped with roller bearing trucks and type A2A quick-service valves in the airbrake system. The other 14 have plain friction-bearing type trucks and are not equipped with the type A-2A air valves. These cars, designed for high-speed passenger service, are 50 feet 6 inches long, 9 feet 1 1/2 inches wide inside, and air conditioned throughout. They are divided into three main sections. The front section contains a completely equipped kitchen. It also has a dining area and a lavatory with one wash basin, shower, and toilet. The center section contains nine folding bunks arranged in tiers of three and a wardrobe closet. The third section, separated from the sleeping compartment by double sound-reducing doors contains a diesel-engine-driven generator set, air conditioning unit, oil-fired hot water heater, temperature control panel, and miscellaneous electrical controls and instruments. This car is equipped with hydraulic draft gear, train steam line system for heat, and AB-1-B airbrake system. Water tanks with a total capacity of 400 gallons are suspended from the ceiling in the kitchen dining end of the car. Water pressure is maintained by an electric motor-driven shallow well jet pump. Detailed instructions for operator's and organizational maintenance of the guard cars are contained in TM 55-2220-210-12.

9-3. Troop Kitchen Cars

The standard domestic service Army troop kitchen car resembles, in outward appearance, the guard car illustrated in figure 2-8. It is a complete kitchen unit used for storing and preparing food for passengers on troop trains. These cars are equipped with two ranges for cooking, cook's worktable, utensil cabinet, two refrigerators, meat cutting table, and two sets of sinks. Other interior equipment includes a hand-fired water heater, overhead water storage tanks, and a shower and dressing room equipped with hot and cold water. Exhaust fans and ventilating blowers exhaust heat and cooking fumes. These cars are 50 feet 6 inches long inside, mounted on double drop-equalizer, swing bolster; passenger-service type, cast-steel, four-wheel trucks, equipped with 5 ½ by 10-inch axles. Air brakes, coupling, and draft gears are all designed for passenger service. Complete details of troop kitchen cars are contained in TM 55-2019.

9-4. Army Medical Department Cars

a. General. Standard ambulance trains operating under the prescribed TOE or TD may be employed by the Army Medical Department for the movement of patients in the zone of interior (ZI) and in the theater of operations. In the ZI, ambulance trains are maintained by the Surgeon General for the movement of patients from various debarkation points to Armed Forces hospitals and in the transfer of patients between medical treatment facilities. In the theater of operations they are used to evacuate patients from hospital or holding units of the combat zone to the communications zone, between hospitals of the communications zone, and from hospitals to aerial and/or water ports of embarkation.

b. Design. Standard ambulance cars have been designed for ease in rapid loading and unloading of litter patients, to maintain a comfortable inside temperature throughout the car even when outside temperatures range from 125° F. to minus 40°F., and for unrestricted interchange of ambulance car railway traffic throughout the United States and Canada, including the underground tubes of New York City.

9-5. Ambulance Trains

a. General. Ten ambulance trains of nine cars each have been authorized by the Surgeon General for strategic location at various places m CONUS for emergency use. All these cars are marked with a Red Cross on the roof and at each end on the sides. These trains consist of six ambulance unit cars, and one each baggage, kitchen and personnel cars, which are briefly described below. Periodic maintenance of these cars will be performed by MECOM Mobile Shop Teams or commercial railway shops using routine procedures discussed in this manual and in SB 7402220-97-E02.

b. Ambulance Unit Car. Within CONUS, ambulance cars are operated over the commercial railroad systems either singly or as part of a train as noted above. This type of car is mounted on two four-wheel trucks with coil spring suspension and roller-bearing journals. These cars, equipped with tight-lock couplers and designed for high speed passenger service on all standard gage railroads in CONUS, are air conditioned throughout. These cars, 85 feet long, are divided into five sections. The front (enlisted men's) section contains seating and sleeping accommodations for six members of the medical staff or operating crew. The rear section contains a compartment for a doctor, one for a nurse, two separate toilet compartments, a shower room, a sterilizer room, closet space, the electrical closet, and a water cooler. The third ward section contains seating and sleeping accommodations for 27 patients and storage closets for bedding, food serving equipment, etc. Section four is the receiving room, it has two large loading doors (to handle litters), a large utility sink, a desk, and locker space. The fifth section is a complete electric kitchen at the rear of the car. Two diesel electric power plants furnish power for operation of the car's electrical equipment when trainline power is not available. A standby receptacle is ,located on each side of the car for yard connection to commercial power. Four water tanks coupled to the airbrake and steam heat system furnish wash water to toilets, shower, kitchen water tanks, etc.

c. Ambulance Personnel Car. These cars, converted from Pullman sleepers, contain 10 roomettes and 5 bedrooms, and are used for ambulatory patients and medical attendants. They are 84 feet 6 inches long, 10 feet 6 inches wide, and completely air-conditioned. These cars obtain electric power from under car axle-driven generator or a.c. standby power (when parked) and heat from steam heat lines. They have locker space for baggage, linen, and car supplies, with roof and frame tanks for water storage.

d. Ambulance Baggage Car. These are conventional type baggage cars, 51 feet, 1/4 inch long, equipped with two four-wheel trucks, roller bearing, coil spring types. They are used

for transporting baggage and supplies incident to the movement of patients between points in CONUS. These cars carry road numbers 89612, 89623, 89625, 89634, 89640, 89637, 89644, 89657, 89661, and 89670 stenciled on each side and on the end doors.

e. *Ambulance Kitchen Car.* This car, mounted on standard passenger-type, roller bearing, fourwheel trucks, is divided into three sections, a dining area seating 16 people, a kitchen and work area in the center, and storage area at the opposite end. It is air conditioned, equipped with electric griddles and steam jet cookers, coffeemakers, an eight-unit electric range, dishwasher, hot food table, icemaker, etc. Heat and electricity are provided from trainline connections. A 180gallon hot water tank in the roof supplies the sink and dishwasher. Cold water is stored in three tanks under the car, with a total capacity of 651 gallons. The storage area contains two 72.1-cubic-foot refrigerators and one 72.1-cubicfoot freezer cabinet for the storage of food. These cars carry road numbers 89600, 89603, 89606, 89614, 89635, 89641, 89642, 89643, 89667, and 189680, stenciled on each side and on the exterior of each end door.

f. Maintenance. Detailed maintenance instructions for all the cars in ambulance trains are contained in SB 740-2220-97-E02. Those cars in standby status will be inspected on a weekly (visual) and monthly (technical) basis. Ambulance train cars in reserve storage status will be inspected monthly (visual) and semiannually (technical). The frequency will be increased if evidence of deterioration is detected. All systems of the complete ambulance train will be given an operational test in conjunction with the monthly technical inspection. This will include moving the cars (exercising) at least two brake applications, check of electrical appliances, etc.

9-6. Ambulance Trains in Theaters of Operations

a. Normally, the standard ambulance train in a theater of operations consists of six ambulance cars, two ambulance personnel cars, and one ambulance kitchen-dining car. This grouping is not considered a fixed requirement nor is it intended to limit the Army Medical Department to a nine- car train. Trains may be regrouped in accordance with rail line capabilities and as the theater patient evacuation load may dictate. The number of cars in an ambulance train may vary depending upon available locomotive power, number and type of patients being transported, and the size of the medical staff.

b. General coverage of the facilities of each type is shown below. All oversea ambulance train cars have the same overall dimensions.

(1) *Ambulance car.*

(a) Steam heating, lighting, and air-conditioning facilities are patterned after those of the domestic ambulance unit car (TM 55-2020).

(b) Ward section berths accommodate 30 litter patients. Six sections are two tiers high, and six sections are three tiers high. Lower berths can be converted to seat four. Upper berths are hinged to fold to the ceiling.

(*c*) A receiving room is located at the platform end. Side sliding doors are provided to receive patients.

(d) The car has medical, communications, and administrative facilities.

(2) *Kitchen-dining car*

(a) Steam heat and lighting are the same as for the ambulance car (TM 55-2020).

(b) There is no air conditioning. The car is ventilated by a blower.

(*c*) The kitchen facilities prescribed by the Surgeon General include a refrigerator, steam tables, urns, etc., to prepare complete meals.

(3) *Personnel car*

(a) Heating and lighting facilities are the same as in the kitchen-dining car.

(b) There is no air conditioning. The car is ventilated by a blower.

(*c*) The car has personnel sleeping quarters, dressing rooms, and toilet facilities as follows: an officer-personnel stateroom two berths high, a nurse-personnel stateroom two berths high, and an enlisted-personnel stateroom three berths high.

9-7. General Maintenance

The transportation railway service in a theater of operations normally will have little passenger equipment to maintain. This equipment will usually be limited to ambulance and hospital train cars and some few passenger type cars used for official travel by higher headquarters. Passenger service in forward areas, if any, will be limited to the movement of troops in any type of equipment available Any passenger service operated in communications zone for the local native population would be by civilian railway authorities. Army-owned passenger equipment in CONUS located at other than military installations having railway

repair facilities, will be repaired by the commercial railway on a contract basis. Repairs to Army owned passenger car superstructure usually will be limited to bodies, roofs, floors, etc., as required to keep the equipment serviceable and safe for the movement of personnel.

9-8. Repair Schedules

a. General. Except in the case of accidents, passenger car superstructures require few extensive repairs during their first years of service. Normal railway practice is to establish shopping cycles ranging from 17 to 24 months, based on the type of service the car is assigned to, -the length of the runs, etc. The condition of wheels, trucks, and draft gear are determining factors in shopping cars for repairs.

b. Procedure. All parts of the superstructure which cannot be repaired in place are removed. Window curtains, aisle strips, seat and back cushions, etc., are taken out and sent to their particular shops for repairs and renovation. Window sashes and doors are stripped of hardware for repair and repainting. Each part is properly marked or tagged for correct replacement. Other items removed may include luggage racks, mirrors, pipe covering, toilet fixtures, screens and ventilations, or any specially installed equipment.

c. Renewing Side Sheets. Damaged or corroded sheets should be renewed. New sheets may be installed by riveting or by the use of machine screws. After the interior finish sheets have been removed, the rivets holding old side sheets may be cut off. It is usually necessary to remove a few rivets in adjacent sheets to release the old sheet. A template should be made so that the new sheet can be cut and drilled accurately: Drill the holes slightly smaller than required and ream them to size after the new sheet is temporarily bolted into place. Enough bolts should be placed to hold the sheet firmly while the other holes are reamed and riveted. Machine screws should be used only for temporary repairs when no riveting facilities are available, or when a rivet cannot be used.

d. Repairs to Roof. To gain access to the underside of car roof, the interior ceiling finish must be removed. Roof patches must be formed to the contours of the roof and carefully fitted. Before the patch is installed, the underside of the patch should be coated with a waterproofing compound. Machine screws tapped into the existing roof are generally used to secure patches. Small defects may be repaired by soldering or welding.

e. Repairs to Inside of Cars. Renewal or repair to the inside finish of passenger-type cars usually is fairly simple, as it is arranged in small sections or sheets. To insure accurate fits, care must be used in renewing a piece. If holes are not properly alined, the section may buckle when installed. Sheets may be spliced by using a batten ,or reinforcing strip behind the butt joint. The batten should be drilled or tapped and the sheets secured to the batten with countersunk head machine screws. Any empty holes resulting from relocation or removal of equipment should be filled with solder and scraped level with the surface.

f. Floors. Composition cement is universally used for passenger car floors. If cracks occur, or it is necessary to remove a section of the floor to make underframe repairs, the floor must be patched. Repair material is mixed to the proper consistency, applied to the section being repaired land leveled with the old floor. If a brass aisle strip passes through a section of floor being patched, the strip should be imbedded in the cement when the patch is made.

Section II. BOXCARS

9-9. General

No all-wood boxcars are now in service in CONUS; however, boxcars with steel under- frames and composite wood-steel superstructures are still used. The all-steel car is a rarity in most foreign countries; most oversea boxcars are constructed with wood or composite wood-steel superstructures. The boxcar components of the Army oversea fleet have wooden superstructures with steel under frames. Consequently, this manual will be largely limited to the types of boxcar that TRS car repair units in a theater of opera- tions would most likely be concerned with.

9-10. Oversea Fleet

An estimated 35 to 40 percent of the 40-ton, knocked-down Army oversea fleet is boxcars. The 40-ton fleet contains boxcars, gondola cars, and the basic flatcar. The superstructure of the box- cars is designed to provide rigidity without the side truss framings carrying any appreciable amount of the total loading. This concept justifies the light framing of the boxcar superstructure and the use of plywood for inside lining without the usual outside steel sheathing used on commercial equipment on railways in the United States. Field erection is expedited by the fact that

the side and end sills of the flatcar are fabricated, punched, and drilled to take the separate components of boxcar side and end framing The components of similar types of the oversea fleet are interchangeable (TM 55-2220-201-35). The maintenance procedures discussed in subsequent paragraphs are generally applicable to the boxcar components of the oversea knocked-down fleet.

9-11. Composite (Wood-Steel) Boxcars

a. General. Composite cars may be of various kinds depending upon what parts are of steel and what parts are of wood. The most common type composite wood-steel boxcar has steel end, steel side and corner posts, steel ends with wooden sides and doors, wood or metal roofs. Steel strips are used in many cases to strengthen the side door and end posts and other similar parts. These strips are secured by wood screws to the respective post requiring support. Strips of angle iron are also used for reinforcing members of wooden superstructures. Figure 9-1 illustrates one manner in which this is done.

b. Composite Wood-Steel Ends. Because of the shifting of lading, particularly machinery and heavy equipment, the ends of a boxcar are usually the part of the superstructure bearing the greatest strain. For this reason, ends must be maintained properly so that none or a minimum of the original strength is lost. When composite

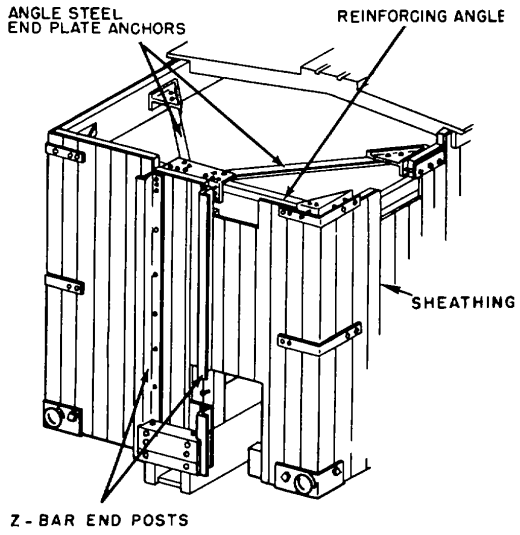


Figure 9-1. Steel reinforced end, composite car.

ends are damaged beyond repair they should be replaced with steel ends, if possible. Repair of steel components is discussed in paragraph 9-13.

9-12. Maintenance of Wooden Superstructure

a. Door and Side Posts. If a door or side post breaks or is severely damaged because of excessive pressure or shocks, the adjoining brace rod must be loosened and the sheathing removed from each side of the post. By jacking the side plate, the post can be freed on the top; it will then be pried away from the rails securing the lining to it. The new post then will be installed and the jack removed. Secure the lining to the new post and replace the sheathing. The last sheathing board cannot be replaced individually without damage to the tongue and groove. Insert the last three boards simultaneously, fit them together, and spring them into place. To prevent or retard end decay and rot, new posts should be dipped in paint or wood preservative before installation. Painting the metal post pockets will also help prevent decay of the wood and rusting of the metal.

b. Side Braces. To replace a broken side brace, carefully pry loose all boards and sheathing attached to it. Remove the broken brace. Reset adjoining posts in proper position and install and secure the new brace.

c. Side Plate. Broken side plates are rare, the most common defect is decay. The most practical repair is to cut out the decayed or damaged part and replace with a new piece, spliced to the ends of the side plate remaining on the car. The roof must be disconnected and raised while the splice is being made. The ends are then bolted to the side plate. If the decay or damage is such that the whole side plate must be renewed, nails in the side sheathing should be driven through after the side plate has been removed. Remove the nuts from the body rods at the top of the plate. Raise and support the entire roof while the plate is being lifted out and a new one set in place. Jacks and jacking braces may be used along with a 3by 5-inch timber sufficiently long to fit under three or four car lines. When jacked, the roof will be supported in the raised position adequately until the new side plate is in.

d. Car Lines. Damaged car lines (the rafters of a car roof) can often be repaired without renewing them. If the damage is in the center portion, the car line may be cut at an angle near its ends. A new beam, cut to fit the portions remaining in place, can be spliced to these ends and bolted. If the car line is too badly damaged to be

repaired in this way, it must be removed and a new one installed. The damaged car line must be disconnected from the side plates and the purlins.

e. Roof Boards. Damaged roof boards may be removed and replaced. After removing the damaged boards, make a careful inspection for any damage to the inner lining (double-sheathed roofs). Repair such damage before putting the new roof boards in place. Minor leaks or light damage can often be repaired by using sheet metal patches over the affected area. Details of wooden boxcars' roof construction are shown in figure 9-2.

f. Running Boards and Saddles. Running boards on tops of boxcars, while no longer required (paragraph 9-14d), where used, will be maintained in a safe condition using AAR Standards as a guide. Nails must not be used in running boards; if screws become loose, they should be removed and the holes plugged. New screws must be applied in other locations and secured down tight. When running board saddles become decayed or split, they will be replaced (fig 9-2).

g. Sheathing. When sheathing is damaged by shifting loading or other accident, it should be promptly replaced. The damaged portion should be removed so as not to damage the remaining portion in the process New boards should be of good quality without large or loose knots. If sheathing boards are wider at one end than the other, care must be exercised to keep the boards plumb while nailing them in place. The boards should be lightly nailed, narrow end first The other end can then be pried into plumb position and nailed down. The groove in the last board ,should not be broken off in order to insert the ,board. The last three or four boards should be fitted together in the form of an arch, they can then be sprung into position and nailed down. Nails should not be driven into the tongues of

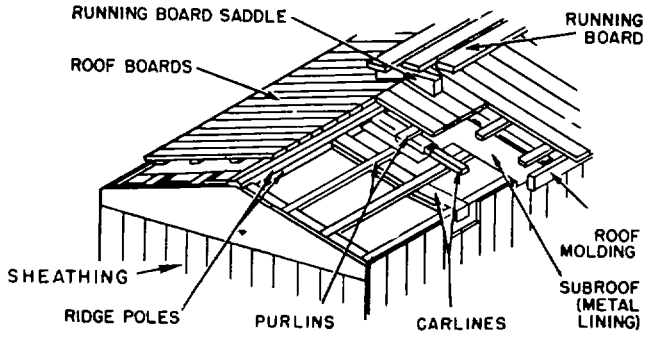


Figure 9-2. Cutaway of wooden boxcar roof.

the boards, as this splits them and causes leaks. It also prevents the boards from fitting tightly together.

h. Flooring. Damaged floorboards should be removed and replaced with new boards. If only one or two boards are to be removed, split one or both of them with a sharp pointed bar to prevent damage to adjoining tongues and grooves. In any case when damaged floorboards are removed, the understructure should be carefully examined for any further damage. The bottom boards of the inner lining must be removed to allow room for removing the floorboards and replacing them. In applying new flooring, the boards may cover projecting bolt or rivet heads. Place the board in position and tap lightly to make an impression of the obstruction. Then cut a notch in the board large enough for the bolt or rivet head and secure the board in position.

i. Lining. When lining is damaged, old boards can be readily pried loose and new ones affixed into place If any large number of boards must be replaced, it is best to begin removing them at the belt rail and work down, or up, as the case may be. In replacing the new boards, the belt rail should be secured before working downward or upward from it. This prevents having the last board positioned next to the belt rail.

j. End Plate. To replace an end plate, it is necessary to detach the end of the running board and free it enough at the attached points so that the end can be raised and blocked at a sufficient height to allow the work to be done. Tie rods and cover sheets at the corners must be removed. Parts of the end of the roof may have to be removed to free the damaged end plate and allow room to attach the new one After the new plate is installed, all disconnected or removed parts should be replaced in reverse order to that in which they were removed.

k. Wood Doors. Top-supported wood doors frequently bind on the bottom door guides. This is caused by loose hanger bolts which allow the door to drop down. The hangers should be removed and the holes plugged. Bore new holes and affix the hangers with new bolts. Pilferage of sealed cars can be discouraged by insuring that all bolts used to secure door guides, door stops, door tracks, door hasps, and like items are fastened with carriage heads to the outside of the car. In making any repairs or replacements of door parts, bolts of exactly the right size should be used so that they can be securely riveted over.

When the rub strip is applied behind the door or sheathing, all wood screws should be tightened so that the heads are flush with the strip.

9-13. Maintenance of Steel Component, Composite Cars

a. General. In many instances wood-steel composite cars were originally wooden cars on which wooden parts have been replaced by steel parts. Many of these composite cars have steel ends and roofs, but still retain the wooden sides. This discussion is concerned with practical measures used in maintenance and repair of these steel components.

b. Bent Steel Ends. Bent steel ends of composite cars usually can be straightened without removing them from the car To straighten an end that is bent outward, the damaged car should be coupled to another car, with the bent end facing the other car to provide a jacking base. After coupling, a pair of trestles should be placed between the cars, one on each side of the opening. A plank should be placed between the trestles A heavy jack, with a wide plank set against the good car as a base, is inserted with the base end of the jack against the wide plank and the other end of the jack against the apex or high point of the bend in the damaged car. By operating the jack, the bend will be forced back into position. If it becomes necessary to move the jack from point to point, the couplers should be blocked before the jack is removed after the first operation. By placing a block between the coupler horn and the striking casting of each car, the slack between cars will remain the same and other jackring operations made easier. If the end is bent in, it will be necessary to remove several lining boards to provide a bearing surface on the end posts for a timber placed crosswise in the car. The jacking procedure will be the same, except that the work will be done from inside to outside and the damaged car need not be coupled If the bend is too severe, too deep and short, or lover too great an area, the piece should be removed and a new end installed.

c. Bent Steel Sides. Steel sides that are bent inward or outward can be straightened by following the basic procedure outlined for bent ends. A jack and a block of wood are required, as well as a convenient means of providing a base for the jack.

d. Steel Roofs. Steel roofs should be painted at the first evidence of rust as a preventive maintenance measure. Bent sheets or roof caps should be removed and straightened without heating. If too badly bent, they should be replaced with new parts Rivets that are rusted through should be burnt off and replaced. Joints should be drawn up tight (to prevent leaks) before installing new rivets or welding.

e. Steel Doors. Top-supported doors will be inspected to insure that the top track and hangers are securely in position, with no projecting parts which interfere with opening and closing the car door. The top track must be level; if an unlevel track is found, it should be repaired promptly to prevent further damage to the door and the car. Badly bent or damaged tracks must be replaced.

9-14. All-Steel Cars

a. General. The repair of riveted all-steel and welded all-steel cars will be very similar, except for the removal and replacement of parts. In the former case, rivets will have to be removed to free the defective part; in the latter case, a defective portion will have to be burned out. The new piece will be attached in the same manner as the part removed.

b. Bent Sheets and Side Plates. Bent end or side sheets usually can be straightened without removal from the car by the procedures discussed in paragraph 9-13b and c. If a side plate is damaged In only a limited area, the area affected can be disconnected from parts attached to it and then cut out. A similar size side plate can then be spliced into place. Rust spots or small holes may be repaired by welding a steel patch over the affected area.

c. Doors, Flooring, and Sheathing The flooring and sheathing or inside lining used in all steel boxcars is in most cases identical so that used in the old all-wood cars The maintenance of wooden superstructure is discussed in paragraph 9-12, that of steel doors in paragraph 13e.

d. Running Boards. The installation of boxcar running boards as a safety measure on top of newly built boxcars is no longer required. However, such running boards on older cars must be maintained in serviceable condition. Fastenings of running boards should be inspected regularly ,and any loose pieces or rivets replaced. Preventive maintenance includes painting at regular intervals to prevent rusting.

Section III. REFRIGERATOR CARS

9-15. General

The framework of a refrigerator car is similar to that of a boxcar, with special facilities to provide and maintain temperatures at a desired level. Refrigerator cars are used to transport perishable commodities or other items dependent upon refrigeration or heat to prevent their deterioration. These cars employ insulated structures to retain heat or cold as desired. They have thick floors, sides, and roofs, are equipped with ice bunkers or some form of mechanical heating or refrigeration. A number of US Army standard gage, domestic-type, 50-ton boxcars have been converted for use as foreign service ice refrigerator cars. These cars have welded underframes, all welded steel sheathed superstructure, steel ends, rigid galvanized steel roof, sliding doors and ice ,compartments, stationary type, at each end, arranged for full or half stage icing These cars have a capacity of approximately 2,000 cubic feet available for loading. Exterior and interior views of these cars are shown in figures 2-1, 2-2, and 2-3. Discussion herein is confined to those features peculiar to any type of refrigerator cars which presents the major maintenance problems. Recently built 40-ton mechanically activated US Army-owned refrigerator cars are operated on certain foreign narrow-gage lines for US forces. These cars are maintained by the 'host national railroads under supervision of US Army personnel as discussed in TM 55-205. These cars are mounted on conventional type trucks, equipped with coil springs and roller bearing journals. This car is illustrated in figure 2-2.

9-16. Flooring

Refrigerator car floors usually are constructed of two layers of wood with some type of insulating material applied between them and covered with a waterproofing material. The principal problem In the maintenance of refrigerator car flooring is to keep the structure waterproof and free from abrasions caused by impacts sustained in loading. If water is permitted to seep through the floor, it will adversely affect the insulating materials, nullifying their efficiency. It also causes the insulation to become soggy and matty, promoting displacement by sagging. Water seepage can be arrested only by constant inspection and maintenance. When abraded conditions of the floor covering are found it must be promptly repaired or replaced. Renewals must be treated with waterproofing compounds to prevent leakage.

9-17. Insulation

Insulation is provided by materials of required thermal conductivity. It should be in blanket form, with a suitable backing and should be applied to car sides and ends in continuous blankets extending from the doorpost around the end of the car to the opposite doorpost. An insulation blanket will extend the length of the floor and another the length of the roof. Insulation should be 3 inches thick on sides and ends and 3 1/2 inches thick on floors and roofs. If temperatures in refrigerator cars are unstable or it becomes difficult to maintain adequately low temperatures, an inspection must be made to determine whether any of the structure has been damaged. If the inner and outer walls, roof, doors, floors, and ends are in good condition, the insulation must be examined for condition and positioning. Dislocation or disability of the insulating material generally can be detected by differences in temperature of the outer shell of the refrigerator car. At such points, sections of the structure (lining, etc.) will have to be removed to gain access to the insulation in the affected area. If the insulation has only shifted, it will merely require relocation and reaffixing. If it has become water soaked or matted, it must be replaced. This same procedure is followed in repairing the doors and padding around the doors. If the canvas covering the padding becomes wrinkled or torn through 'use, it should be smoothed or reattached.

9-18. Doors

a. General. Doors of refrigerator cars generally are provided in pairs and located centrally in the side of the car. They are thick and adequately insulated. The edges of the doors are beveled, matching the bevel of the door frame. This permits free-swing clearances and tightness of fit when the door is closed. Some of the difficulties that are encountered in maintaining refrigerator ,car doors include lack of airtightness and disability of the locking devices.

b. Airtightness. The airtightness of car doors is dependent upon the closeness of fit, and the manner in which the padding around the door)has been applied. If the padding was loosely applied, permitting it to become folded or wrinkled, leaks will develop. Padding can become hardened and lumpy, thus contributing to air leakage. When such conditions are found, defective padding will be replaced. Sprung doors or door

frames resulting from wood warping may cause leakage. In this event, such members will be replaced and the doors refitted.

c. Locking Devices. The hardware of refrigerator car doors includes the hinges, cranks, locking bars, and levers. These members generally are constructed of malleable iron, affixed with bolts passing completely through the door and anchored with a nut on the outside. These locking and hinge devices become inoperative due to rust, wear, deformation or breakage, and looseness. If one of the devices cannot be repaired or firmly affixed, it should be replaced with a new one, and the portion of the car body or door to which it is affixed be repaired to afford a satisfactory support or anchor point. Airtight closures are not possible if these devices malfunction.

9-19. Roofs

a. General. There are several types of roof used on refrigerator cars: board, plastic, inside or outside metal, and all-steel. It is important that car roofs be kept leakproof to prevent decay and corrosion of the car structure and/or damage to the loading. Roofs and all parts such as roof boards, plastic coverings, metal roof sheets, purlins, carllnes, ridge poles, etc., should be inspected periodically and any leaks or damage repaired. Neglect of damaged supporting members may result in the development of stresses that open seams and joints, thereby causing leaks in the roof.

b. Repairs. Outer or inner roofs which leak should be repaired or the leaky member replaced. In the case of plastic covering, the leaky portion should be recovered This may be applied directly over the old roofing. Where cars have inside sheet metal roofs, care will be taken to insure that 'nails used to secure the outer boards do not extend into the car interior and puncture the metal lining. This type of repair generally can be effected without removing the entire roof; however, It may be necessary to remove some roof boards or parts of the running board. If car lines, purllns, ridge poles, or planks must be replaced, it usually will be necessary to remove the entire portion of roof. In some types of construction, car lines are so installed that removal is impossible without disassembly of the roof. If only one car line must be replaced, it can be removed piecemeal and a new one installed in two sections, to be spliced after installation Purlins, if defective, can be replaced by removal of the roof, or a section of it. Steel roofs deteriorate through rust and corrosive action. Rusty areas should be cleaned with a steel brush to remove all traces of oxidation, then the areas should be coated with red lead or some other rust inhibitor, and painted.

9-20. Waterproofing

The greatest single problem in the maintenance of refrigerator car superstructures is the prevention of water seepage into the inner sections of the car, walls, ends, and floors. This seepage will In time corrode the metallic members of the structure and decay the wooden portions. To correct this action waterproofing is required Various remedies include the use of compounds and the application of plastic sheets. Impregnating all lumber used with a creosote mixture makes the material highly resistant to moisture. When repairs are made to the car body, all joints should be sealed with waterproofing materials. The area immediately behind the ice bunkers or brine tanks is a critical area and requires greater care because of its proximity to condensate water and brine solutions contained in these tanks or0 emanating from them. In the case of box bunkers, in which the walls are formed by the ends and sides of the car, waterproof construction and repair are essential.

9-21. Overflow Pipes

Overflow pipes are used in conjunction with brine tanks and are provided to drain off excessive moisture As the ice melts, the brine solution rises in the-tank until the level of the overflow pipe is reached. At this point, excess solution is drained into a tank and retained to be discharged later, or when no damage to the tracks and roadbed will ensue. Overflow pipes become clogged with sludge and incrustations. This must be removed during routine maintenance and the pipes thoroughly cleaned, since a stoppage of the overflow pipes will result in overflow of the brine tanks and flooding of the car. The overflow pipe valve will be periodically cleaned also and maintained In good working order.

9-22. Bunkers

a. General. In some refrigerator cars, the retaining wall or box bunker bulkhead is used to form one end of the ice bunker. In these cars the bulkheads are arranged as collapsible members that may be swung upward, or to one side, and fastened out of the way This is done when commodities which do not require refrigeration are transported, so the space normally occupied by

the bunkers may be used for loading. This unit must be maintained in good order; the fastening devices should be inspected to assure that they will retain the bulkhead in position. If the bulkhead is permitted to shift, it may damage the loading; if a bulkhead in use as a wall fails, it will permit the ice to mix with and damage the goods being shipped. Antirust and corrosion measures will be taken for all metal portions (para 9-19*b*).

b. Basket Bunkers. Basket bunkers (when used) are hung just below the roof in the center of the car, applying refrigeration where temperature is the highest. In some cases, brine tanks are similarly installed These bunkers and tanks must be removed periodically and thoroughly cleaned. Any rust or corrosion should be removed and coatings of preservative material applied. If leaks develop, the tanks must be removed and the holes soldered.

Section IV. GONDOLA CARS

9-23. General

The gondola is an open-top freight car with sides and ends. The floor or bottom is level and may be solid or provided with bottom doors. They are used for the transportation of bulk freight. Classifications include high side, low side, drop end, drop bottom and general service. A typical drop end type gondola is illustrated in figure 9-3.

9-24. Oversea Fleet

The knock-down 40-ton oversea fleet includes both high-side (48-inch) and low-side (18-inch) gondolas. These are basic 40-ton flatcars with sides and ends added. The ends are fixed, and the sides have pressed-steel truss members with a substantial chord angle. Sheathing is 1 1/2-inch tongue and groove wood. Since the basic flatcar body is designed for 40 tons, the sides are not primarily designed to serve as truss members The Jow-side unit may be provided with drop ends, which drop outward. Because of its 18-inch side height the low-side gondola will serve as an auxiliary for the flatcar fleet (TM 55-2220-201-35).

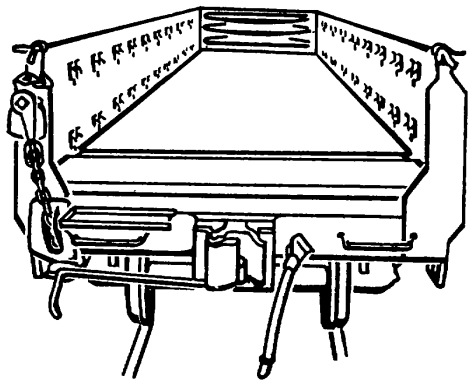


Figure 9-3. End view, drop-end gondola.

9-25. Maintenance and Repair

a. General. Gondola cars as a class receive the roughest usage of any freight cars, and as a result are subject to corrosion which weakens the car structure. Since this class of car represents a large proportion of all freight cars in service, adequate maintenance and repair schedules must be established and adhered to. It should be re- membered that as the gondolas of the 40-ton oversea fleet are basically flatcars, maintenance of their superstructure is, therefore, a matter of upkeep of the sides and ends. When stripped of sides and ends, damaged or otherwise, they can be returned to service as flatcars. Conversely, since gondola sides and ends are unit packed for shipment and storage, flatcars may be converted into gondolas at depots where stores are available, at railway salvage depots, or as a last resort by cannibalization.

b. Major Repairs. Repair work of a major nature begins with dismantling the car and removing all material or mechanisms that require straightening, repair, or renewal. The car is then moved to where necessary repairs can be made to those parts of the car remaining intact. When truck repairs are indicated, the frame is jacked and the trucks moved out as outlined in paragraph *4-4b;* new and repaired floor sheets can be fitted while the trucks are out. Side and end repairs can be made at this time, also. These repairs may include replacement of repaired sections, renewal of parts, all riveting and welding required on the superstructure and the installation of safety appliances. Car trucks, couplers, airbrake cylinders, etc., are reapplied, airbrakes tested, and the car is ready for painting and release for service.

c. Minor Repairs. Defective side or floor sheet may be cut out at the stakes or at cross bearer and sills to make light or minor repairs (organizational and direct support maintenance). Patch sheets will then lap over the edges of the remaining portions of the old sheet. If the sides become distorted (steel-sided cars) from the strain of excessive loads, a turn buckle bar of sufficient length to hook over the sides of the car will pull them back into shape. If the side of a car is bent in, it can be jacked out to the proper position with an ordinary jack. The side plates at the opposite side of the car can be used as an anchor or base for the jack by bracing properly with thick timbers so as to distribute the force over a wide area. When the end of a gondola is caved in, it may be jacked out by placing heavy timbers against the crosstie, one on each side near the center sills, and arranging jacks between the timbers to push out the caved-in portion. At the .same time a jack should be placed across the end of the car to push out the corners. If the end is 'bulged out, it may be jacked back into position with a jack based on another car coupled end to end with the bulged car. Cars with damaged ends often have pulled in corners. These should be shaped to the proper position by jacking at the same time repairs are made at the ends. Repair of damaged sides and ends of 40-ton gondolas may involve only replacement of wooden parts. This requires carpenter skill only. If side structural steel truss members of high-side gondolas or steel posts of low-side gondolas are damaged to the extent that replacement is necessary, the type of repair and the place for performing repairs becomes a matter of judgment on the part of the responsible maintenance personnel.

Section V. HOPPER CARS

9-26. General

A hopper car is a freight-carrying car with the floor sloping from the ends and sides to one or more hoppers, which are capable of discharging their entire load by gravity through the hopper doors, a self-cleaning feature. The hopper compartment doors may be opened or closed as required. The door operating gear consists of a shaft, ratchet gear, paw], and chain linkage. All hopper doors are provided with locking devices to secure the doors in closed position. Covered hopper cars are permanently inclosed, equipped with tight-fitting covers and doors. They are used for the shipment of chemical products (sulphur, etc.) in bulk.

9-27. Major Repairs

a. Dismantling. For complete rebuild or major repairs, hopper cars are disassembled on an outlying track in the following manner. At the first position the ends, crosstie braces, side gussets, and coupler carrier bolts are removed. The car is then moved to the second position where the sides and long hoods are dismantled. Side sheets are not cut loose at this time. Couplers and draft riggings are then removed and parts needing repair sent to the proper shop. At the next position the hopper slope sheets, floor sheets, cross bridges, drop doors, hinge pins, and hinge butts are removed. If the cross-bridge sheets are to be scrapped, it will be necessary to cut off the crossbridge and center cross-bridge braces. At the final dismantling position the remaining parts are removed. These parts include inside hopper sheets, long hood support, lever guides, floating lever guides, center sill stiffeners, hinge, butt supports, outside sill stiffener and center sills, body center plates, back center sill fillers, center braces, draft sills, draft and end sill gussets, top follower guides, handbrake steps, brake mast step, uncoupling device, body bolsters, and airbrakes; old rivets should be removed from all material to be repaired or used in replacement.

b. Reassembly. Material to be reapplied to the car should be positioned at the proper place along the assembly track. Bolsters and diaphragms should be assembled at some point other than the erecting track so that they can be applied to the car in a single compact unit. Reassembly is accomplished at several positions along the erecting track in the following sequence:

(1) After assembly, place the body bolsters and diaphragms on four trestles at opposite ends of the first position. Fit the center sill to the bolsters and square them. Apply the following units: long hood supports, body side bearings, bolster diaphragm fillers, end sills, side sills, striking castings, striking casting braces, draft attachments, top follower guides, center braces, center plate fillers, sill stiffeners, center crossbridge brace, brake rod anchor assembly, brake rod anchor, body center plates, lever connection guides, floating lever guide fillers, and hinge butt supports.

(2) Lower the car body, with this equipment installed, from the trestles onto service trucks and roll to the next position to be riveted.

(3) Apply the following parts to the riveted construction: inside hopper sheets, inside hopper sheet angles, side sheet gusset plates, cross-bridge sheet, cross-bridge braces, hinge butts, and drop doors.

(4) Move car to floor construction position and apply the following parts: floor strut angles, long hood, outside hopper sheet, angles, and the lower floor angles.

(5) Move car into position for riveting these members To facilitate work underneath the car, it should be raised from the service trucks, blocked at the draft sills, and lowered to rest on them.

(6) Upon completion of riveting, retruck the car and move to next position for application of ends and sides. Then apply following parts: corner caps, side sheet ties, tie reinforcements, center floor plate fillers, draft and end sill gusset plates, and diagonal struts.

(7) Move to next position for riveting of these parts and the application of safety appliances. These include inside steps, brake mast supports, brake mast rests, sill steps, grab irons, and ladders.

(8) Move car to final assembly position. Remove the service trucks and apply the repair trucks. After car body is lowered on trucks, connect the brake rigging and install draft gears, couplers, carrier irons, and all required locknuts. Gage the car for proper coupler height, check side bearing clearances and test airbrakes. Car is then ready for painting.

9-28. Minor Repairs

Because of the basic similarities of hopper cars and gondolas, the procedures outlined in paragraph 9-25c governing light repairs to gondolas are also applicable to hopper cars. Drop doors and drop-drop operating mechanisms are also quite similar on gondolas and hoppers and the same repair procedures will apply. The sides of hopper cars, near the bottom, have a tendency to rust out prematurely from rain, melted snow, etc., seeping through the sand, coal, or other bulk cargoes they usually are loaded with. Often such a car cannot be shopped and a temporary repair is required. This can be accomplished by affixing repair sheets to the inside of the car of adequate size to cover the damaged area. Replacement plates should be bolted or welded in position as deteriorated side sheets will rarely withstand riveting. Repaired areas should be painted to retard further corrosion.

Section VI. DUMPCARS

9-29. General

An air dumpcar is an all-metal car so constructed that its contents may be discharged to either side or both sides of the track through doors in the car sides or drop doors in the floor; by means of an inclined floor and side doors; or by tipping the car body sidewise by means of compressed air secured from the trainline. Dumpcars are used to move large quantities of earth in excavation and construction work along rail lines. It is used for ditching, trestle filling, coal handling, and emergency work occasioned by landslides or washouts. The majority of side dumpcars are provided with sides that turn down and out coincident with the tilting of the body. As the entire side of the car turns down, it forms a chute over which the load in the car is discharged (fig 9-4).

9-30. Operation

The dumpcar body is mounted on a steel underframe, pivoted longitudinally over the center sill so as to discharge on either side. When dumping, the hinges, which are riveted to the center sill under the car body, rock on the pedestal castings, which are riveted to the center sill. Vertical dump cylinders on each side of the car perform the dumping and righting of the car body. The body is supported in such a manner that all members between it and the underframe are in compression, with the result that the shock of loading is carried directly through the truck spring to the roadbed Air dumpcars are provided with air storage reservoirs located on the car and charged through the trainline from the locomotive. Dumping of air dumpcars usually is accomplished by turning the handle of a control valve located on the platform of the car. This charges or exhausts the operating (air) line. The locks are operated by a separate air cylinder connected to the operating line through a cutout cock. Closing the cutout cock leading to any latch cylinder cuts out the dumping operation of the particular car. The dump body is tilted by the dump cylinders (as shown in figure 9-4) one of which is mounted on each end of the body. On some cars the same pair of cylinders is used to tilt the body in either direction, reversal of dumping being accom

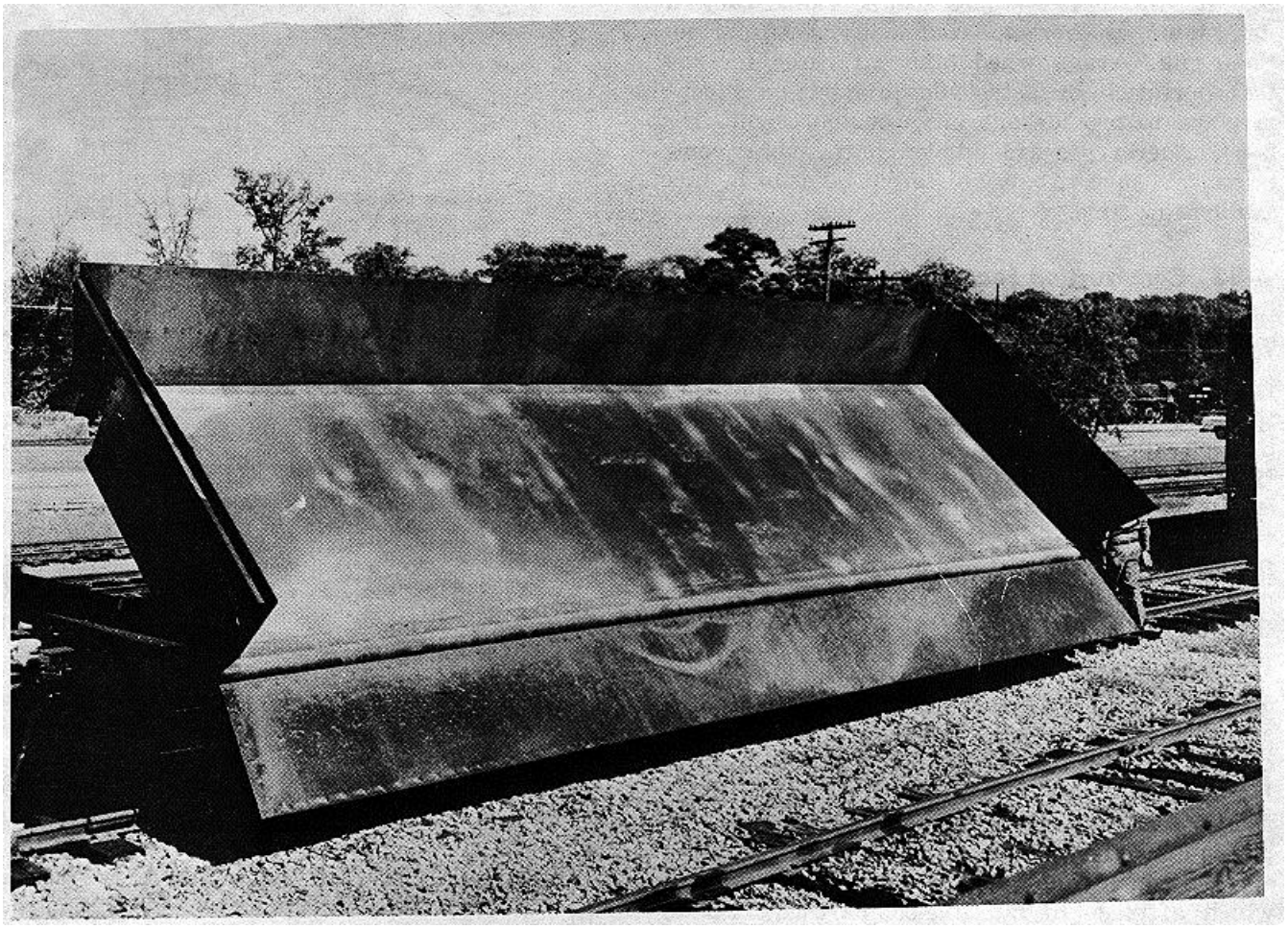


Figure 9-4. Dumpcar, body tilted.

plished by swinging the cylinders around so they push the body the other way. The locks on this type of car are also reversed manually by means of a short pull rod located transversely on the center underframe of the car. On other types dumping is accomplished by operation of a dumping valve handle which is moved to dump position. A direction valve conveniently and conspicuously located will indicate clearly to the operator the direction In which the car will dump.

9-31. Maintenance and Repair

The simplicity of construction of the average dump car minimizes maintenance and repair problems. These cars are ruggedly constructed to stand rough usage As in the case of other freight cars with steel superstructures, light repairs can be accomplished without heavy equipment. Straightening of bent and deformed members may be accomplished with the use of jacks and supporting timbers as discussed for other car superstructures. Patching of floors, sides, and ends follow the same procedures discussed for hopper cars and gondolas. Maintenance and repair procedures for associated equipment of air dumpcars such as air cylinders, trucks, underframes, couplers, draft gears, and brake facilities are the same as any other freight car.

Section VII. TANK CARS

9-32. General

The superstructure or tank of tank cars generally is constructed of steel or other metal plates riveted or fusion-welded together. Tanks designed to be lined on the inside are unit will double-welded butt joints to provide a relatively smooth interior surface. Tanks of riveted construction are composed of several overlapping sheets, preformed to general contour and riveted

together at the overlapped seams. Tanks vary in design in relation to commodity transported Some, like Army-owned tank cars used for the transportation of petroleum products, are constructed to provide one large compartment (fig 2-6), other types are divided into several compartments so as to carry different kinds of liquids at the same time.

9-33. Construction Features

a. General. The superstructures of tank cars (shells) must be constructed of materials which resist corrosion, or be lined with corrosion-resistant material. For this reason, tank shells are built of alloyed steel, nickel steel, or aluminum. Insulation is sometimes required to maintain an even temperature for certain commodities. Some viscous liquids require the application of heat to facilitate unloading. This normally is accomplished by steam coils installed inside the tank shell.

b. Dome. Most tank cars are equipped with domes (fig 2-6). These are cylindrical chambers affixed to the top of the tank to provide a means of filling the tank to its full cubic capacity. Domes also serve as reservoirs for the accumulation of gases and fumes that develop in the transportation of some liquids. The size of the dome is governed by the size and class of the tank to which affixed. In multiple-compartment tanks, each compartment is equipped with a separate dome. Domes are provided with vents or safety valves to exhaust accumulated gases or vapors. The details of dome and outlet valve arrangement are shown in figure 9-5.

c. Outlet Valves. These valves (fig 9-5) are installed on the underside of the tank and provide a means of emptying the contents of the car. They must be constructed in such a manner that they will be capable of passing the type of lading carried, whether it be free-flowing liquid (aviation gasoline) or heavy viscous materials (crude oil, molasses). The outlet valve must be able to pass the contents without blocking or stopping. It must also be made of materials which resist corrosive action. Outlet valves extend downward from the bottom of the tank to a point below the underframe members, providing a ready access. These valves are opened and closed by a mechanism housed in the valve and activated by a rod which passes from the valve upward into and through the tank body, and is affixed to the inside of the dome housing.

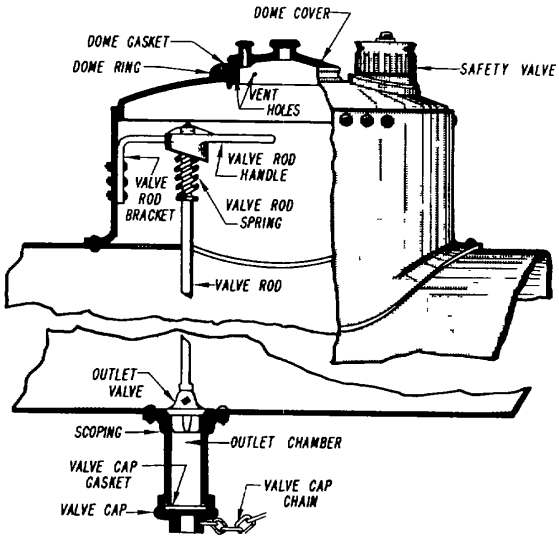


Figure 9-5. Arrangement of dome and, bottom discharge outlet.

d. Tank Cars in Theaters of Operations. Petroleum products are the principal commodities moved in tank cars in oversea theaters of operations. Tank cars of AAR, DOT, and CONUS specifications, modified by emergency austerity demands, are standard for oversea theaters. The United States type center-sill construction between bolsters is incorporated in car designs, and side buffing is provided for In designs where hook-and-link couplers are used as shown in figure 7-6. Shock is absorbed by diagonal bracing applied to the bolster center-sill connection; this is preferable to the conventional European use of side sills for buff resistance Standard bottom outlet valves and dome safety valves are incorporated in tank car specifications, which are available from the US Army Mobility Equipment Command, St. Louis, Mo.

9-34. Maintenance and Repair

a. General. A leaky tank is one of the more common defects encountered in tank car maintenance. The first and most vital tank car maintenance principle is: CAUTION-NEVER APPROACH A L,EAKING TANK CAR WITH AN OPEN LIGHT. This is applicable whether or not the inspector knows what the lading consists of. In fact and in practice, an open light (match, torch, candle, or lantern) must NEVER be used in the inspection of tank cars, empty or loaded.

b. Leaking Tanks. A leaking tank car should have its load transferred as soon as possible; if leaking badly, temporary repairs must be accomplished. One method is to stuff waste or rags, impregnated with a heavy lubricant into the opening to arrest the flow. Where the rupture is not too great, soap or clay may be adequate. These are strictly temporary expedients, only performed to provide time to transfer the lading to another car. If possible, the empty tank car selected to receive the transferred lading should have held a similar commodity. Otherwise the lading may be contaminated or two noncompatible substances become mixed. If possible, the load should be transferred by gravity flow. If a gravity transfer cannot be made, siphon or pressure may be used. Air pressure should be Judiciously used and only on cars loaded with heavy oils, and at a very low level Leaks in seams can be calked temporarily by packing them with twine or lead-wood pushed into place with a sharpened piece of wood or bronze After the twine calking has been tamped into place, soap should be patted over it to form a ridge. Tools made of ferrous metals must not be used in tank car repairs of this type, since there is a danger of igniting flammable lading or gases by sparks that might occur when ferrous metals are brought into sharp contact. A dent in a tank car does not require any attention if not leaking.

c. Outlet Valve Leaks. Many leaks occur at the outlet valve underneath the tank. These generally are caused by a leaking valve inside the tank. This type of leak often may be stopped by tightening the cap on the bottom of the tank nozzle. If this does not remedy the trouble, a blind gasket can be placed over the end of the tank nozzle and the cap screwed up tight against it. Sometimes such leakage can be stopped by removing the dome cover and moving the valve up and down several times. Bad leaks often develop in the tank nozzle of the outlet valve, because of freezing in cold weather. As water is heavier than oil, any formed from condensation will be at the bottom of the tank and be first to run out. This water often freezes in cold weather, bursting the tank nozzle, and causing a leak when it thaws. In such cases, the leaky valve should be replaced after the car is emptied and before reloading.

d. Tank Heads. These members, the ends of the tank shell, are frequently bent. This results from being struck by the shifting load of another car or as a result of a blow from a projecting object or building. Such dents may be straightened by bumping them from the inside with a heavy maul or a tool made from an old axle. To facilitate this operation, a little heat may be applied to the dented areas of the tank head while the bumping is being done. The tank head must never be heated to a bright red heat, as this will cause the member to buckle. When straightening tank heads, never strike the head directly, as that will mar the sheet or member It is preferable to use a flat-faced swage or wooden maul against the surface. If the tank head is badly staved in, it can be straightened by means of a jack placed between timbers and braced against the other end of the car. While it is frequently possible to straighten dents in tank heads and shells without removing the tank from the car frame, more ,extensive damage requires removal. The tank should then be set up on skids or large horses for repairs.

e. Shell Plates. The repair or straightening of dented shell plates generally is performed in the same manner as repairs to tank heads, discussed in *d,* above. When it is necessary to remove a tank plate, care must be taken to avoid damaging it when removing the old rivets. Rivets should be driven (headed over) on the outside and bucked on the inside, using a well designed bucking bar instead of another hammer. Rivets must be tight. A loose rivet can be detected by holding a finger on the rivet head and tapping the rivet lightly with a hammer. If loose, it will vibrate slightly. Loose rivets must never be calked. If they leak, they must be replaced.

f. Safety Valves and Vents. The lading often runs into the top of the safety valve when the car is being loaded. Asphalt or similar products may congeal and prevent the valve from unseating at the prescribed pressure. If inspection indicates a faulty safety valve, remove the valve from the tank. To disassemble a standard safety valve, remove the valve plug from the center of the valve. Back out the valve stem until the spring follower and spring are detached. Remove the valve and valve stem from the housing and inspect the valve. If the valve or valve seat is pitted or rough, the contact surfaces may be ground smooth with emery powder. All parts of the valve should be cleaned before reassembly. Spring tension will be adjusted and the reassembled valve tested for correct pressure opening.

g. *Dome Covers.* Dome covers require little maintenance, as they seldom fall in service. Dome covers are provided with 1/2-inch holes just underneath the flange of the cover. These holes

are necessary to permit the release of gases and pressure less than that required to lift the safety valve. Dome covers without these holes should never be applied. It is necessary to inspect to see that the dome cover chain is secured to the tank so that the cover cannot slip off and fall.

h. Tank Car Tanks. After any repairs requiring welding, riveting, calking of rivets, or hot or cold forming to restore tank contour of tank cars used in Interchange service in CONUS, the tanks must be retested as prescribed by paragraph 173.31, DOT Regulations (49 CFR Part 173) before return to service. Glass, lead, or rubberlined tanks must be retested before the lining is renewed. Interior heater systems must be retested before return of the car to service after repairs to, or renewals of any part of the system.

9-35. Tank Cleaning

a. General. When it is necessary to repair a tank, It must be thoroughly cleaned so as to be safe to enter. Often the fumes remaining after the load has been discharged are highly flammable or toxic. The procedures following are prescribed for different commodities.

b. Tanks Carrying Oils. This type of tank is best cleaned with steam. A jet of stem will be blown into the tank, the steam vapor will condense on the tank wall and run down to the bottom of the tank, taking the oil with it. Before applying the steam, it is necessary to remove the outlet cap and to open the tank valve, thereby allowing the condensate and oil to run out. After 4 to 5 hours of steaming, a carman should enter the tank and sweep out the residue The final step is a thorough flushing with cold water.

c. Tanks Carrying Acids, Fats, Heavy Greases. Tanks that have transported these commodities must be cleaned by boiling out. This is accomplished by filling them with water and adding four or five hundred pounds of caustic soda. A steam hose should then be inserted into the tank and turned on. Tanks of this type should be boiled for 48 hours before the solution is drained out. After this treatment, the tank must be thoroughly washed out with cold water before it is safe for a workman to enter. As this caustic solution will cause painful burns if it comes in contact with the skin, rubber boots, gloves, and oil-skin clothing should be worn when the solution is handled.

Section VIII. FLATCARS

9-36. General

The Department of Army 40-ton flatcar is specially designed for foreign service as the basic component of the knocked-down fleet The other components (except tank cars) are simply flatcars with their respective types of superstructure (high- and low-side gondolas and boxcars) added. These components are shipped packaged and are easily assembled as outlined in TM 552220-201-35. For the movement of ordnance and engineer materials, or other equipment weighing over 40 tons, a standardized Army 80-ton flatcar has been designed to meet most theater operating conditions. No conversion of this car is anticipated. It is mounted on six-wheel (3-axle) trucks to avoid exceeding the low axle load limit on track and bridge structures of foreign railways. The 80-ton flatcar, like the 40-ton flatcar, is shipped knocked down and packed so that it can be assembled in the field with minimum effort.

9-37. Depressed-Center Flatcars

A minimum design capacity load of the depressed-center flatcars (fig 2-5(2)) In service on the railroads of the United States is 70 tons. Body-mounted airbrake cylinders and foundation brake gears of the conventional type of flatcar cannot be used in depressed-center flatcars; hence, brake cylinders with a separate foundation gear for each truck are required. Cylinders may be truck mounted or body mounted. Rail movement of ordnance and engineer material and other equipment with vertical dimensions exceeding those permissible for mounting on regular 40or 80-ton flatcars is sometimes possible on depressed-center flatcars; however, the load limit of the depressed-center flatcar will not equal that of the regular 80-ton flatcar. The usefulness of the depressed-center car is measured primarily by the added headroom it affords.

9-38. Maintenance and Repair

a. General. The life expectancy of flatcars- is materially affected by the adequacy and quality of the maintenance and repairs performed. This is because of the tremendous load transported on flatcars. The structural material used in flatcar construction consists of members rolled, shaped, extended, or cast. These various members are combined and fabricated to form a complete struc-

ture. This is generally accomplished by riveting and/or welding. Since many CONUS flatcars have wooden decks or flooring and many foreign flatcars are partly of wood construction, repairs to both types will be discussed.

b. Repairs to Wooden Flatcars. The repair of underframes was discussed in chapter 5, so this discussion is limited to superstructure repairs only. The only superstructure on the average flatcar is the platform or flooring. The wood flooring normally used is of 1 3/4-inch lumber, squared or provided with a shiplap Joint. The floorboards are cut out for the side and end stake pockets. When renewing a car floor, all old nails and spikes should be removed and the car structure repaired if needed. When old flooring is relaid or new flooring is applied, it should be fastened with 30or 40-penny spikes, depending on the thickness of the lumber Flooring usually is milled In widths that lie with a face of 5 1/4, 7 1/4, or 9 1/4 inches. Two spikes should be used in each end of the board where it Is affixed to the side sills, two more in the area over each center sill, and one where the board is affixed to the intermediate nailing strips. This applies when 5 1/4-inch boards are used, additional spikes may be necessary when wider boards are laid Flooring should project about 1 inch beyond the outer edge of the side sill. It must be laid In alinement if the boards are presawed to length. If random and mill lengths are used, they may be marked with a chalk line and sawed straight across after they are nailed into place. Any sill that is slightly tipped or twisted must be blocked straight before the flooring is applied. It is also necessary to see that the car is properly trussed to secure the required camber or curvature of the sills before laying a new floor, since this enables the car to withstand concentrated loads on its center.

c. Repairs to Steel Flatcars. Steel flatcars are of three general types: the ordinary flatcar with steel sills and wood or steel floor, the depressed center flatcar, and the well-hole car. Cars of the latter types are generally equipped with riveted steel floors. When steel floors are used, they are riveted to the sills with soft iron rivets. These rivets have large flat heads and are inserted from the top and driven from the lower side of the car floor. The floors generally are made of steel plate, riveted directly to the side, center, and intermediate sills of the car Defects developing in these floors usually are caused by the lading they carry In some cases, the floors warp and buckle; in others, holes may be punched through the floor sheets. Often rivets are sheared off by lading sliding across the floor. Holes in a steel floor may be repaired with patches, or the entire sheet can be replaced, if necessary. Floors that have buckled may be removed and straightened ,or relaid It is often necessary to weld over old rivet holes and punch or drill new ones, because buckled members tend to stretch when straightened Sheared rivets should be replaced whenever found. Other repairs to depressed-center and well-hole flatcars are accomplished in accordance with methods applicable to ordinary steel flatcar repair.

PART THREE

HEATING, LIGHTING, AND AIR CONDITIONING

CHAPTER 10

TRAIN LIGHTINIG

10-1. General

The three commonly used systems for train lighting are the axle-generator system, the head-end system, and the storage system.

a. Axle-Generator System. The axle-generator system is the one most frequently used for train lighting. In this system the drive is the means of transmitting power from the axle of a railway car to the generator. The types most generally used are the belt drive and the direct drive. The belt drive is the earlier development and is still found on many cars Exposure of the operating mechanism to severe winter weather and to the dust and grit encountered in hot, dry weather creates problems in wear, loss of tension, and general maintenance that have been impossible to overcome. Moreover, the larger generators demanded by air conditioning have made the belt drive impractical. The more efficient direct drive does not present these problems, since a shaft replaces the belt. An additional advantage of the direct drive is that power transmission losses are relatively low.

(1) *Belt drive* (fig 10-1).

(a) The driving pulleys or sheaves are affixed to the car axle, and the driven pulleys are secured to the armature shaft of the generator. Over this set of pulleys, an endless flat belt or a V-belt is installed, and as the car axle rotates, the belt transfers this power to the generator The combined V-belt and gear drive employes four or six V-belts to drive a set of sheaves mounted on a gearbox hung from the truck end sill. These sheaves drive a gear shaft which, by means of a bevel gear, drives the generator mounted on the car body through a propeller shaft equipped with universal and slip Joints.

(b) A spring arrangement gives practically constant belt tension throughout any movement of the generator caused by belt stretch or by the car's rounding a curve. This arrangement, termed an underframe suspension, gives constant belt tension for 8 inches of generator travel.

(c) The suspension must be lubricated properly to prevent wear of the parts and loss of proper alinement Grease may be forced through the bronze bearings in which ample grease space is provided Grease can be applied by a compression cup installed in the supporting shaft and bearing or by a grease gun if the proper fittings are applied to the suspension. As the bearings are not subjected to heating, petrolatum Is preferable to cup grease.

(d) When necessary to remove the generator from the suspension, block up the generator to take the weight off the suspension shaft.

Loosen the lockscrew and remove the grease cap at one end. Then insert a bolt into the tapped hole in the end of the suspension shaft and pull the shaft out of the bearings and lugs. The Insertion of the bolt provides a means of applying a drawing force; or if the shaft is free, it serves as a handhold with which the shaft may be withdrawn. If the supporting shaft resists efforts to withdraw it, remove it by further disassembly of the bearing cap.

(2) *Direct drive.*

(a) Direct drive generally employs a minimum number of moving parts. In one type, all wearing parts run in a constant bath of light oil where they are completely sealed and protected from ballast, dirt, water, snow, Ice, or other foreign matter. This type of drive transmits power from the axle of a railway car to a generator through a mechanism consisting of a gear unit, a propeller shaft, and a clutch This drive consists of an unsplit hypoid gear mounted in a gearcase ,on a standard axle (fig 10-2). This gear is in mesh with a pinion connected to a propeller shaft suspended between universal joints, one of which

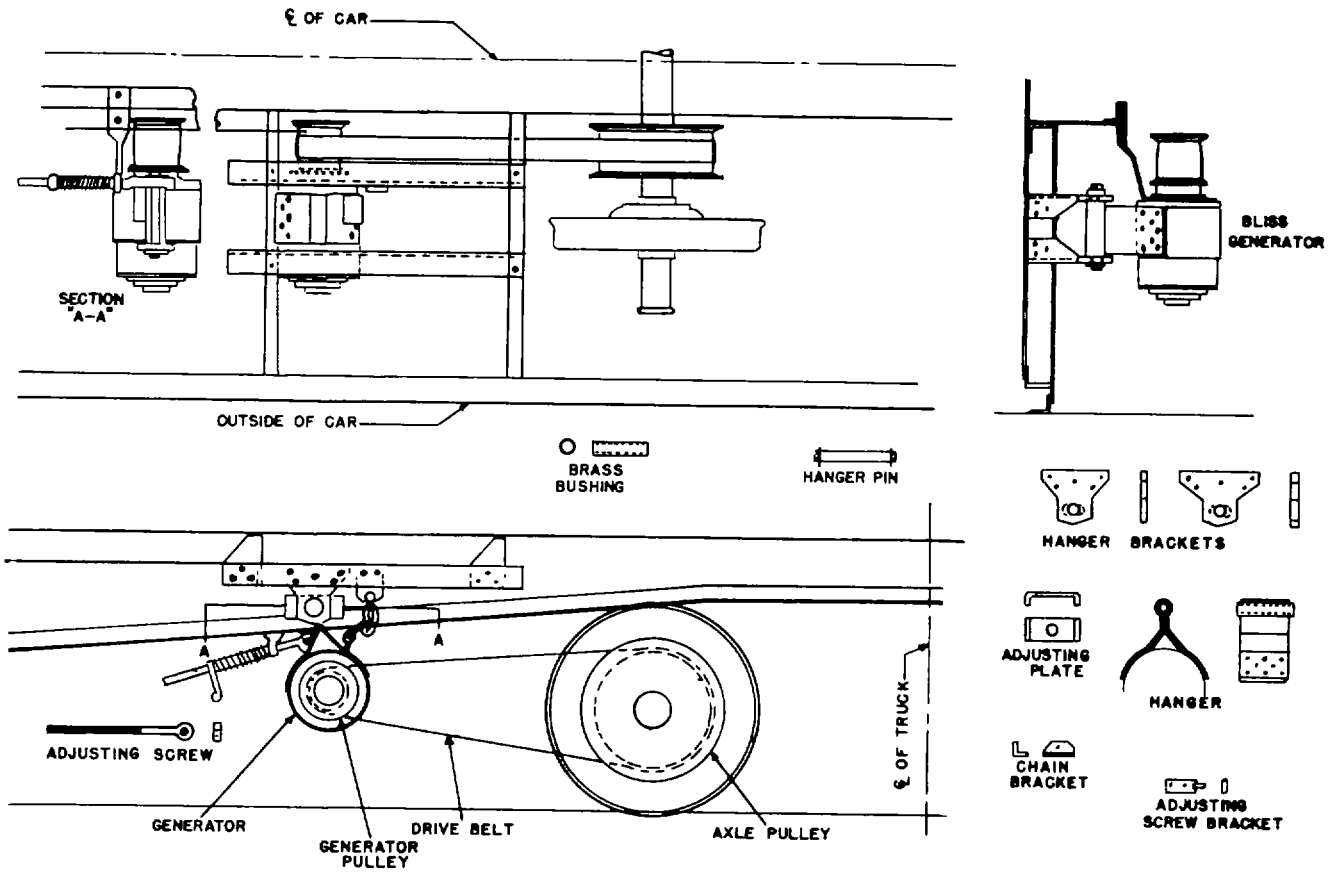


Figure 10-1. Arrangement of an axle-generator belt-drive system.

is attached to an automatic clutch installed on the generator. The hypoid gear, through the pinion, universal joints, and propeller shaft, drives a generator (fig. 1043) or in some cases a generator mounted on the car body. The automatic clutch mounted between the generator and the propeller shaft completely disconnects the drove from the generator in case of excessive overload 'or when the car speed falls below 5 miles per hour. It also eliminates shock loads when cars are being shunted. The automatic release permits motoring of the generator for electrical inspection or driving of the generator motor or generator by standby alternating current.

(b) Correct lubrication is the most important item of maintenance in connection with these drives. Proper lubricants must be used and the correct oil level maintained to prevent drive failure Extreme care must be exercised to prevent the admission of dirt or other foreign matter into open filler plug holes.

(c) If inspection reveals a rapid loss of oil, the oil seals should be examined and replaced if necessary. Oil leaks must be corrected as soon as possible. They may be detected by a wetting of the surface around the sealed points. A slight seepage is a natural condition.

(*d*) A program of regular inspection and replacing of small parts will prevent excessive wear and possible generator drive failure. This includes those parts apt to become worn, loose, or broken, such as rubber mountings, bolts, nuts, washers, oil seals, gaskets, bearings, etc. Drives correctly installed and maintained will operate satisfactorily without attention for long periods.

b. Head-End System.

(1) The head-end system was one of the first electrical systems to be used in train lighting. In this system, the generator may be located in the baggage car and driven by a steam turbine or a gas engine, or *it* may be installed on the tender or locomotive and driven by a steam turbine. In a few cases, the head-end system has been used on modern streamline trains, power being generated by two or more diesel-engine generator sets located in the locomotive or in a power car at the head of the train.

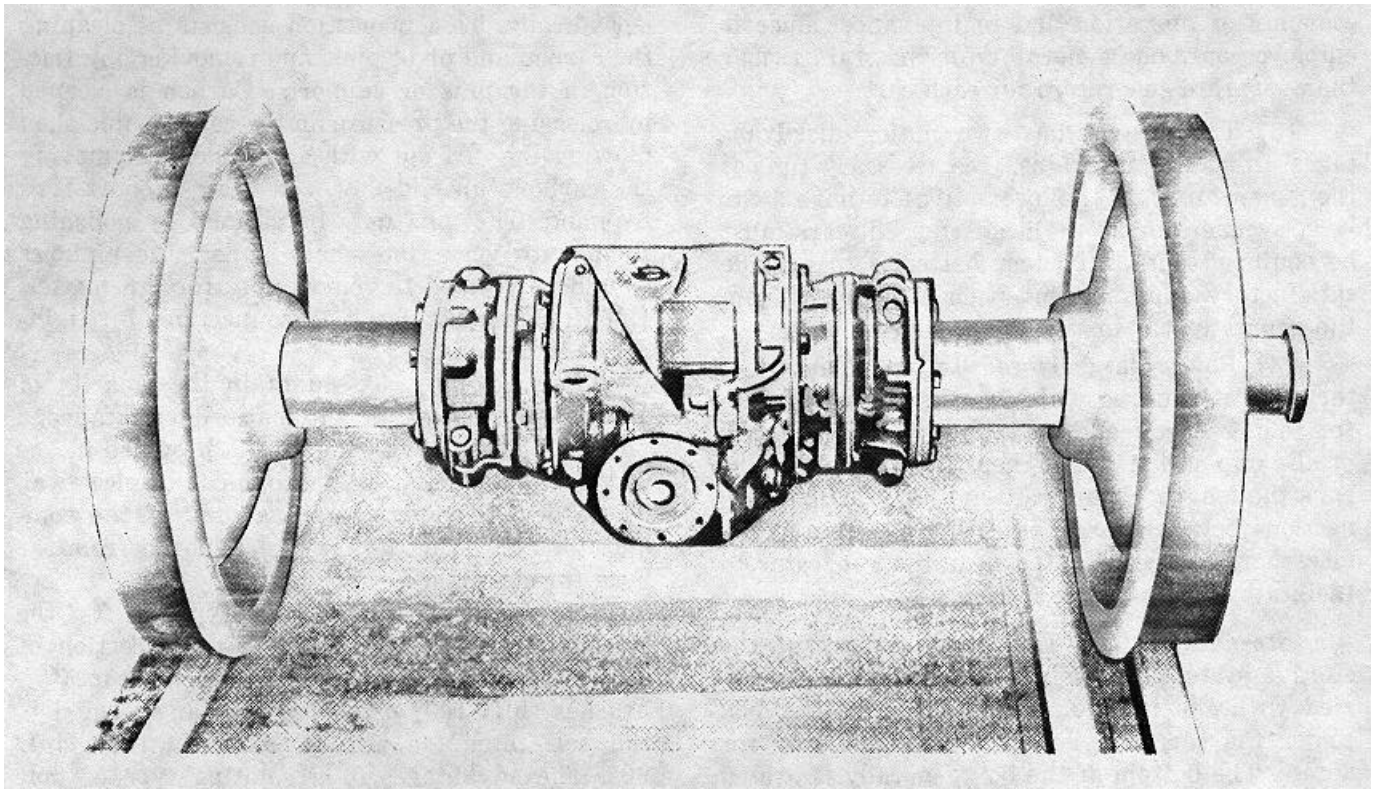


Figure 10-2. Generator drive gearcase mounted on a standard axle.

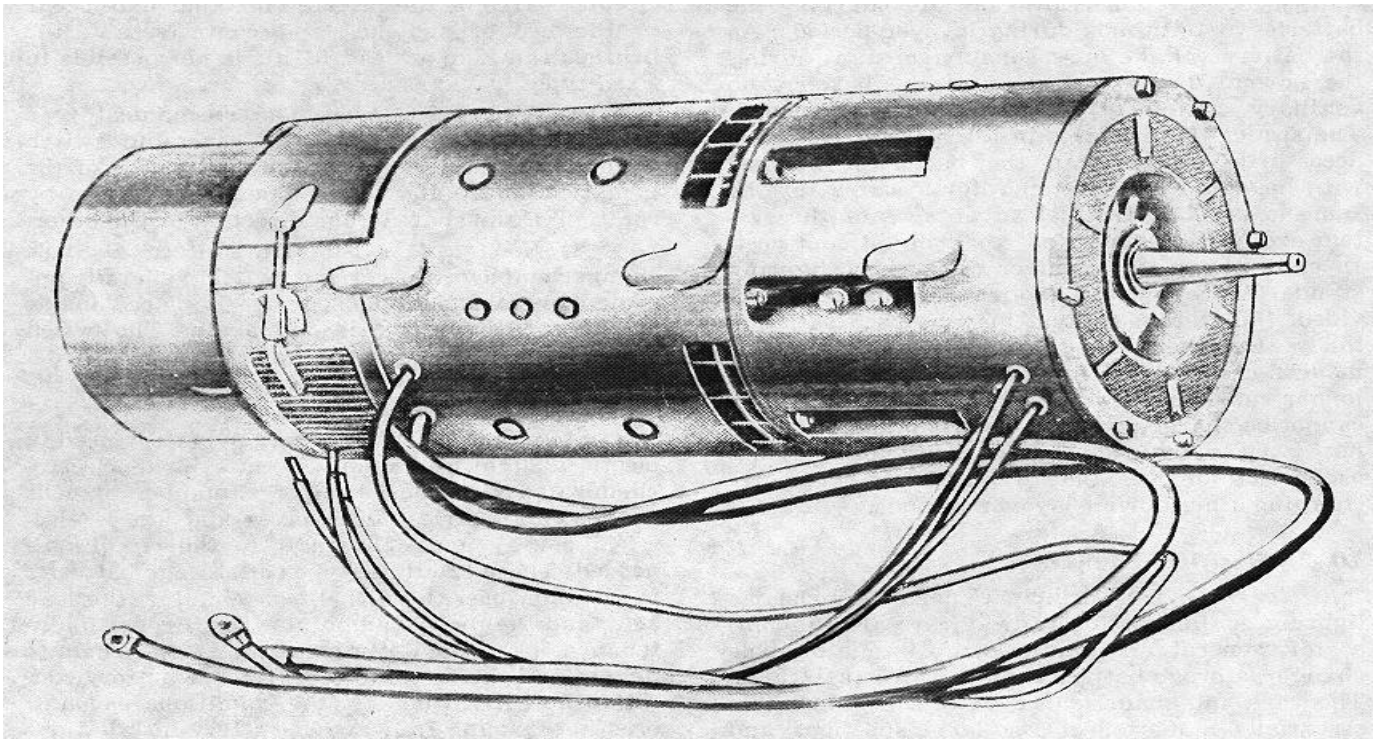


Figure 10-3. Type GP 25-kilowatt generator.

(2) The main advantage of the system is its economy of operation and maintenance, since it employes only one generator for the train rather than separate generators for each car.

(3) The system has two major disadvantages. In making up trains, it is necessary (unless the generator is on the locomotive) to have a car with a generator at the head end. All cars must be equipped with sufficient batteries to provide satisfactory illumination when uncoupled from the generator car of the power source.

(4) Power is delivered to the cars by a three-wire trainline which serves to compensate for voltage drop and to keep the same voltage at all lamp sockets throughout the train. The line runs the length of the train and has flexible connections between cars. Indicating and control devices normally are located near the generator to facilitate control of the system.

c. Storage System. The power supply of the storage system consists of storage batteries carried with the individual cars, usually in a box ,under the car. The box has a hinged door for access. The bottom of the box generally is grated rather than solid to keep the batteries cool A charging connection is provided for charging the batteries at terminals during layover periods As the battery voltage is reasonably constant during the normal discharge period of the battery, no auxiliary equipment or controls are employed. The size of the batteries in the storage system is necessarily larger than the batteries required with head-end or axle-generator systems for the same load. The principal advantages of the system are its simplicity and small investment cost. In older types of passenger cars where lighting standards are low and no air conditioning is provided, the storage system may be used satisfactorily. However, the system is impractical for modern cars because of their increased loads and longer runs As the batteries of a storage system cannot be charged while the car is underway, it is necessary to have adequate capacity for the longest period of use and to schedule enough recharging time during layover periods.

10-2. Electrical Equipment

a. General. The principal parts of electric lighting equipment for railway cars are the generator, generator regulator, lamp regulator, pole changer, storage batteries, and electrical fixtures. The care and maintenance of this equipment is essentially a matter of regular inspections and keeping it meticulously clean.

b. Regulators. Regulators should be checked periodically. This inspection consists of cleaning the carbon and pivot pins, and removing any friction in the pins or supports. Carbon is cleaned by releasing the pressure on the carbons and then blowing the dirt out with an air hose, or moving the carbons up and down on their support rods by hand The pins may be cleaned by polishing them with very fine emery paper; the pinholes should be reamed to remove any foreign matter. Upon reassembly, check all connections for tightness and cleanliness.

c. Pole Changer. To maintain the polarity of an axle generator, an automatic device called a pole changer is used. This unit is provided in one of three types: rotating, mechanical, or electrical. 'These devices generally are a part of the commutator end head and may be removed from the head for cleaning.

(1) *Rotating type.* This type shifts the brushes of the generator when the direction of axle rotation changes. On a two-pole generator, brushes shift 180° or through an angle equal to the pole pitch, on a four-pole unit, they shift 90°. The advantages of a rotating type of pole changer are that the continuity of the armature circuit is free of the interference that may occur in the use of switches and contacts, and the brushes can take a "lead." This is not possible in fixed types.

(2) *Mechanical type.* The mechanical type of pole changer consists of a reversing switch which is mechanically operated by rotation of the armature shaft and which opens and closes by rotation of the shaft In one direction or the other.

(3) *Electrical type.* The electrical pole changer employs a reversing switch, generally operated by solenoids. This device is placed inside the car with other electrical apparatus. The switch is thrown one way or the other automatically, depending upon the direction of rotation of the generator armature.

d. Storage Battery. The storage battery used in electrical lighting in railway cars in an electrochemical device consisting of a number of cells connected in series. It receives and stores electrical energy and delivers it to the circuits as needed. There are three types of storage batteries in common use: the nickel-iron alkaline, the lead acid, and the nickel-cadmium types. Proper maintenance of storage batteries require the carman to understand the factors that influence battery condition and life. Some of the conditions encountered in servicing railway car battery installations include overcharging and undercharging, cor

roded terminals which prevent the delivery of sufficient current under heavy load; cracked or broken cases with resultant loss of electrolyte, short circuits within the cells; worn out plates, chipping of active material; freezing, sulphation; growth of positive plates; shrinkage of negatives; and electrolyte below the tops of the plates Terminals and cable connections must be kept clean of corrosion and electrolyte maintained at level adequate to cover the plates. Defective batteries will be replaced with new or rebuilt ones.

(1) *Alkaline type.* The alkaline cells (fig 10-4) consist of nickel-plated steel grids containing tubes or pockets to hold the active materials of nickel and iron oxides. The electrolyte for the nickel-iron cells is a solution of potassium hydroxide, more familiarly called caustic potash.

(2) *Lead type.* In this type, the plates are lead and lead oxide immersed in an electrolyte of dilute sulphuric acid (fig 10-5).

(3) *Nickel cadmium type.* The nickel cadmium battery (fig 10-6 and 10-7) consists of 10 cells, with intertray connectors and terminal adapters for SAE positive and negative cables, contained in two five-cell crates. This is a 12-volt battery, and IS used in the mechanically activated refrigerator cars discussed in paragraph 9-15.

10-3. Lighting Fixtures

a. General. Railway passenger cars are lighted with fluorescent and/or incandescent lamps. The maintenance problems of fluorescent lights are somewhat more complicated than those of incandescent lamps. Regular cleaning of fixtures, glassware reflecting surfaces, and lamp tubes is necessary. Lamp replacement is an important service function.

b. Fluorescent Lamps. These do not screw into sockets like incandescent lamps. There is a lamp holder at each end of the unit specially designed to hold the lamp in contact. Lamp tubes are removed or inserted by a quarter turn in these holders. The tube should be inserted gently to avoid twisting the lamp base, but firmly enough to lock it into contact so it will not be jarred loose by vibration. The average life varies with the size. The 14-watt lamp most commonly used on trains is rated at 1,500 hours Normal failure of fluorescent lamps is caused by the gradual dissipation of the material with which the electrodes at either end are coated When this active material **,is** used up, the lamp will blink on and off. At the end of life, the lamps usually show a dense -blackening at the ends Blinking of the lamps, failure to start, etc., are symptoms of some defect requiring attention, not necessarily the lamp tube itself The fault may be in the starter or the ballast or other parts of the system.

c. Maintenance Procedures.

(1) *If a fluorescent lamp fails to light.* Check to see that it is properly seated in the sockets. If it is, check the starter If defective, replace the starter. If the lamp still falls to light, test the tube in another circuit; if defective, put in a new lamp tube.

(2) *If a lamp is slow a**t** starting.* Check the starter switch and replace if defective. Low line voltage and an improper ballast may also cause sluggish starting.

(3) *If only the ends of a lamp light.* This indicates a short circuit in the starter, which should be replaced. Starters long in service frequently fail in this manner. This trouble should be promptly corrected or the circuit inactivated by removal of the lamp or starter, since a lamp tube glowing only at the ends will shortly burn out.

(4) *If a lamp blinks on and off.* This usually indicates failure of the lamp. The starter should be replaced as a test, if blinking continues, then renew the lamp. Low circuit voltage, low ballast rating, low temperatures, and cold drafts may also cause difficulties of this nature. Blinking lamps should be corrected promptly, as this condition will ruin both the lamps and the starter.

d. Incandescent Lamps. The principal maintenance required for these lamps is regular cleaning and the replacement of blackened or burned out lamp bulbs. Regular inspection of circuits should be made for cracked or broken reflectors, damaged sockets, frayed insulation, faulty switches, etc. Preventive maintenance includes replacement of damaged parts or adequate repairs and cleanliness. Insulation in particular is affected by dirt, oil, and moisture, which cause failures.

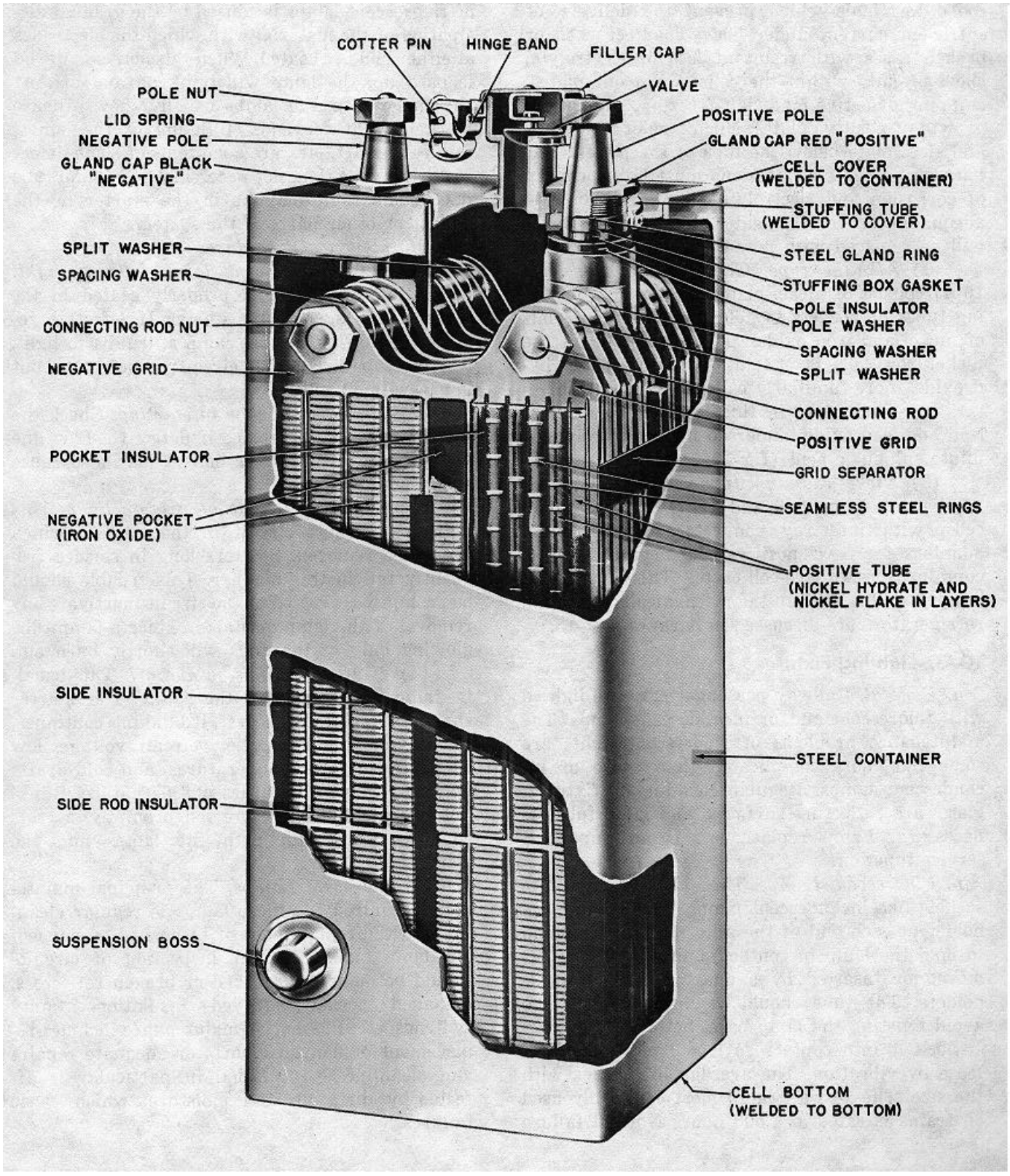


Figure 10-4. Alkaline type of storage cell.

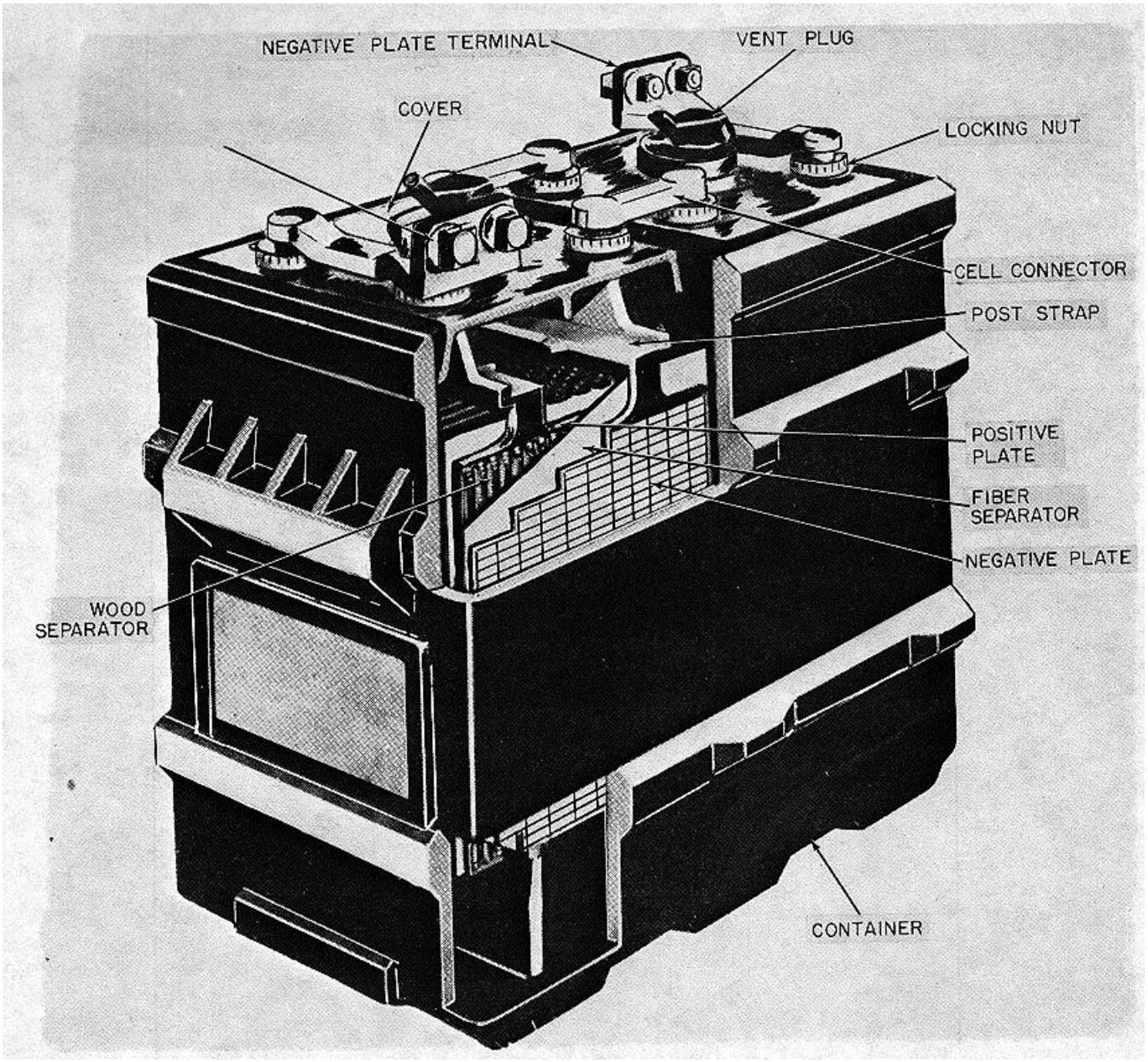


Figure 10-5. Lead-acid type of storage battery.

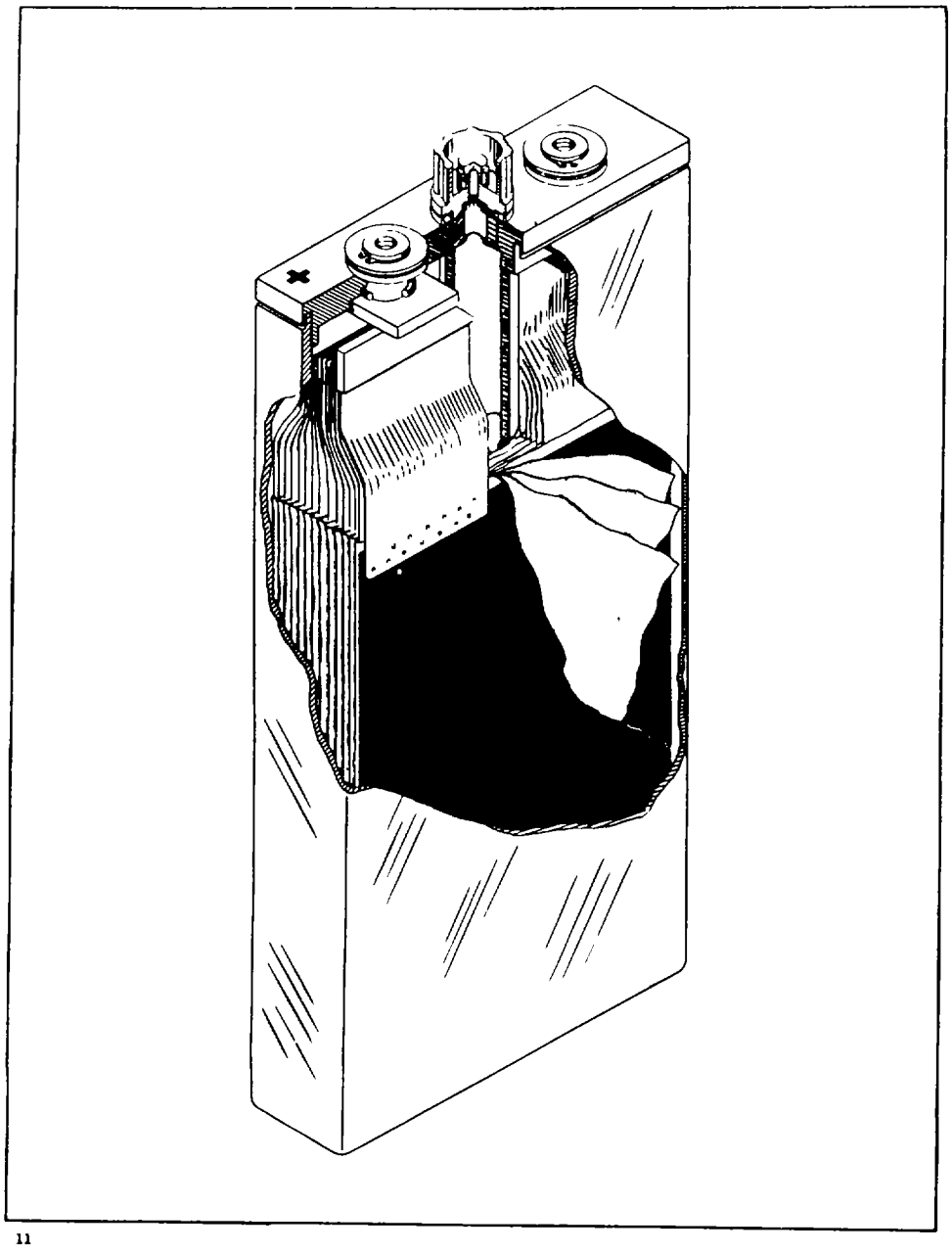


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Figure 10-6. Cutaway view, nickel cadmium battery.

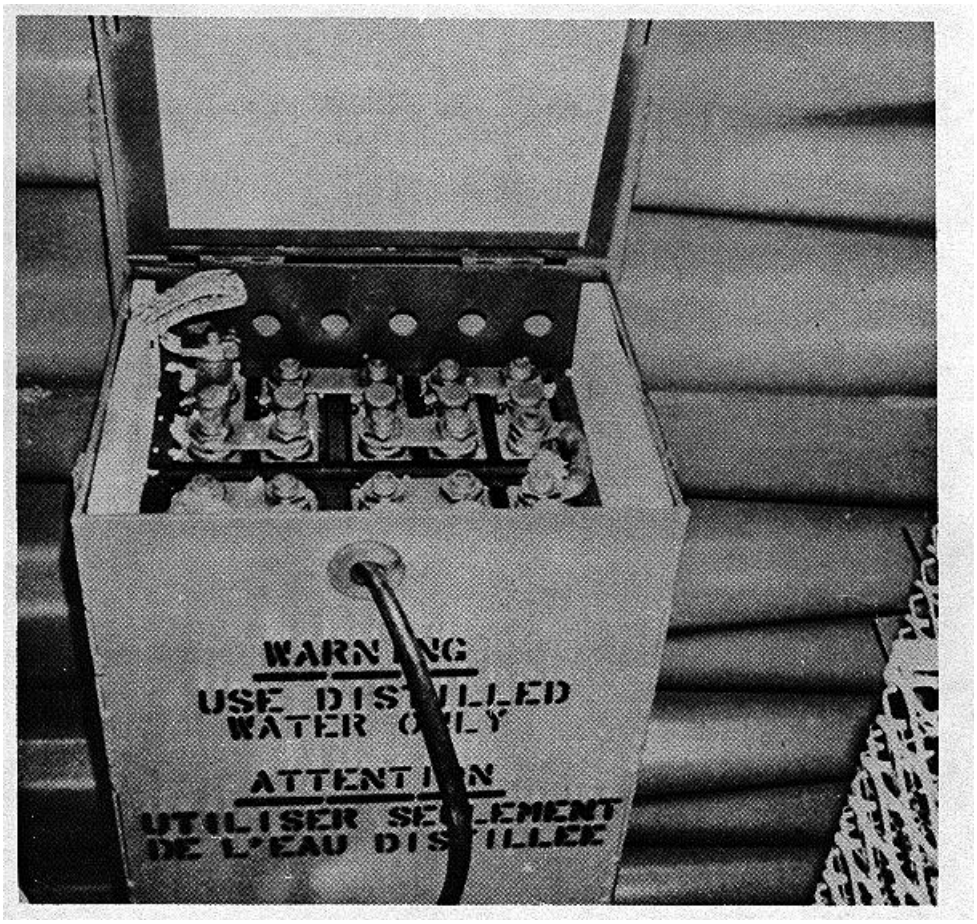


Figure 10-7. Top view, nickel cadmium battery.

CHAPTER 11

HEATING

11-1. General

a. Modern passenger cars are heated almost universally by finned-copper, floor-mounted, steam radiation systems supplied from the locomotive. A well-constructed and insulated car will use from 250 to 350 pounds of steam per car per hour. In some cases, passenger cars are heated by a split system which includes an overhead air circulating system provided with heating and cooling coils and floor-mounted standing radiation along the car sides Some electric trains and motorcars use electric heat in which resistance coils usually are placed beneath the seats or along the walls.

b. The systems most generally used today include the steam vapor, the vapor zone, the straight vapor, and the direct steam (or pressure heating) systems The vapor zone system uses steam at high pressure; the others use steam at low pressure. The steam vapor system is controlled manually. In other systems, automatic control is furnished by thermostats and electrically energized valves. The steam vapor system is used on most Army-owned passenger cars.

11-2. Steam Line Connections

The steam line of each car has a flexible metallic conduit (fig 11-1) at each end. These conduits permit connection to the line of an adjacent car. One end of the conduit connects to the car steam heat line, and the other end, which is equipped with a steam coupler, connects to a similar coupler on the flexible metallic conduit on the adjoining car. A steam coupler includes a body, a spring-loaded locking lever, and a gasket which is held in place by a spring Flanges and lugs provide a means of interlocking connections so that the couplers are steamtight. The end trainpipe valve provides a means of shutting off the steam in the main steam line at each end of a car. A conduit includes an end-valve connector, an upper body, an intermediate casting, a lower body, and a coupler adapter The coupler adapter is joined to the lower body by means of a sleevetype joint. All these parts are connected to form ,a complete unit by use of steamtight ball-type joints which permit the conduit to adjust to any irregularity.

11-3. Pressure-Reducing Valve

The pressure-reducing valve (fig 11-2) located in the locomotive provides a means of maintaining a predetermined reduced pressure on the train steam-heat line. Outside temperatures and the number of cars in the train are the factors which govern the pressure desired Steam is admitted to two chambers in the valve. It passes an open or unseated auxiliary valve, which is held

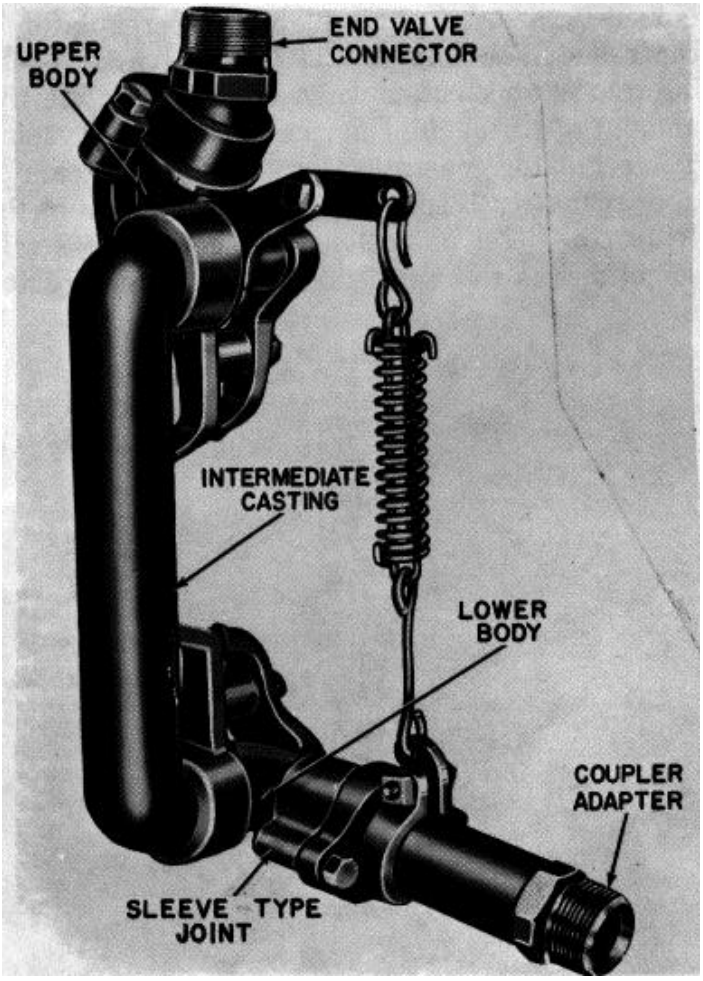


Figure 11-1. Flexible metallic conduit.

open by a spring-loaded diaphragm. As pressure increases in these chambers, a piston is moved, which forces open an auxiliary and a main valve in the pressure-reducing valve Steam under pressure is permitted to move upward and exert pressure on the spring-loaded diaphragm The auxiliary valve is then closed. As the steam condenses and pressure is reduced, the spring again exerts tension on the auxiliary valve and opens it, simultaneously opening and closing valves and ports as required. The spring on the springloaded diaphragm can be adjusted to exert any desired pressure.

11-4. Steam Vapor System

Steam at atmospheric pressure is termed vapor. At sea level, its temperature is 212°F. In theory, when steam condenses to water it gives off the same amount of heat that was required to convert the water to steam. Therefore, the maximum quantity of heat is recoverable when vapor at 212°F. condenses to water at that temperature, imposing the least drain on the boiler or heat source. The vapor system, like all other steamheat systems, obtains steam or vapor from the locomotive or from a flash boiler. Delivery is controlled by a pressure regulator. The regulator is controlled manually in the locomotive by opening and closing cutout valves which regulate the amount of steam entering the car radiator system. The regulator generally is set to deliver steam at approximately 15 pounds pressure per car in the train. In diesel operations, the source of steam sometimes is contained in a specially constructed heated car carried at the head end of the train. In figure 11-3, a vapor system for one side of a passenger car is shown provided with manual controls. An identical system is employed on the other side of the car. The system consists of a ,steam line underneath the car; a vapor regulator, -also on the underside of the car; and two vapor ,cutout valves from which heating coils of the car are supplied. The vapor regulator is connected to the steam line by a branch pipe in which a constant-pressure valve and a standard cutoff valve are installed.

11-5. Vapor Zone System

a. Compared to the manual system, the vapor zone system gives a better distribution of heat and a more uniform temperature through the car and makes more economical use of steam. In this system the car is divided into two or more zones or areas, each of which is fitted with a separate radiation system and a flow-limit valve under independent thermostatic control. Radiation, usually of the fin-tube type, may be located either on the floor or overhead. A one-zone diagram of this type of heating system is shown in figure 11-4.

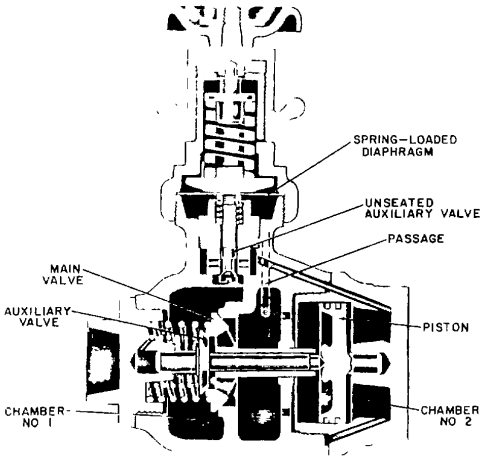


Figure 11-2. Pressure-reducing valve.

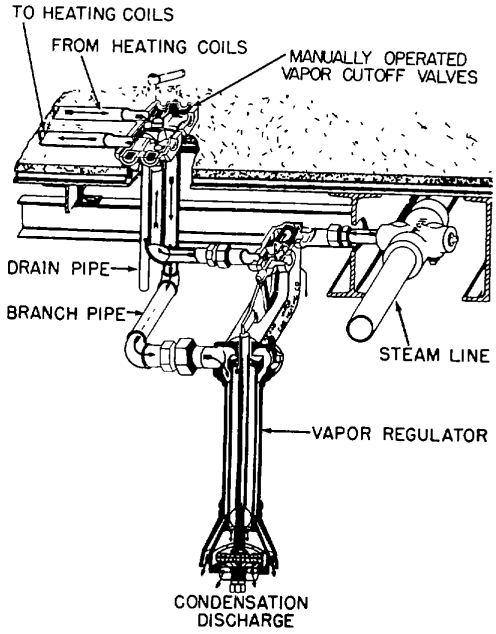


Figure 11-3. Hand-operated vapor system.

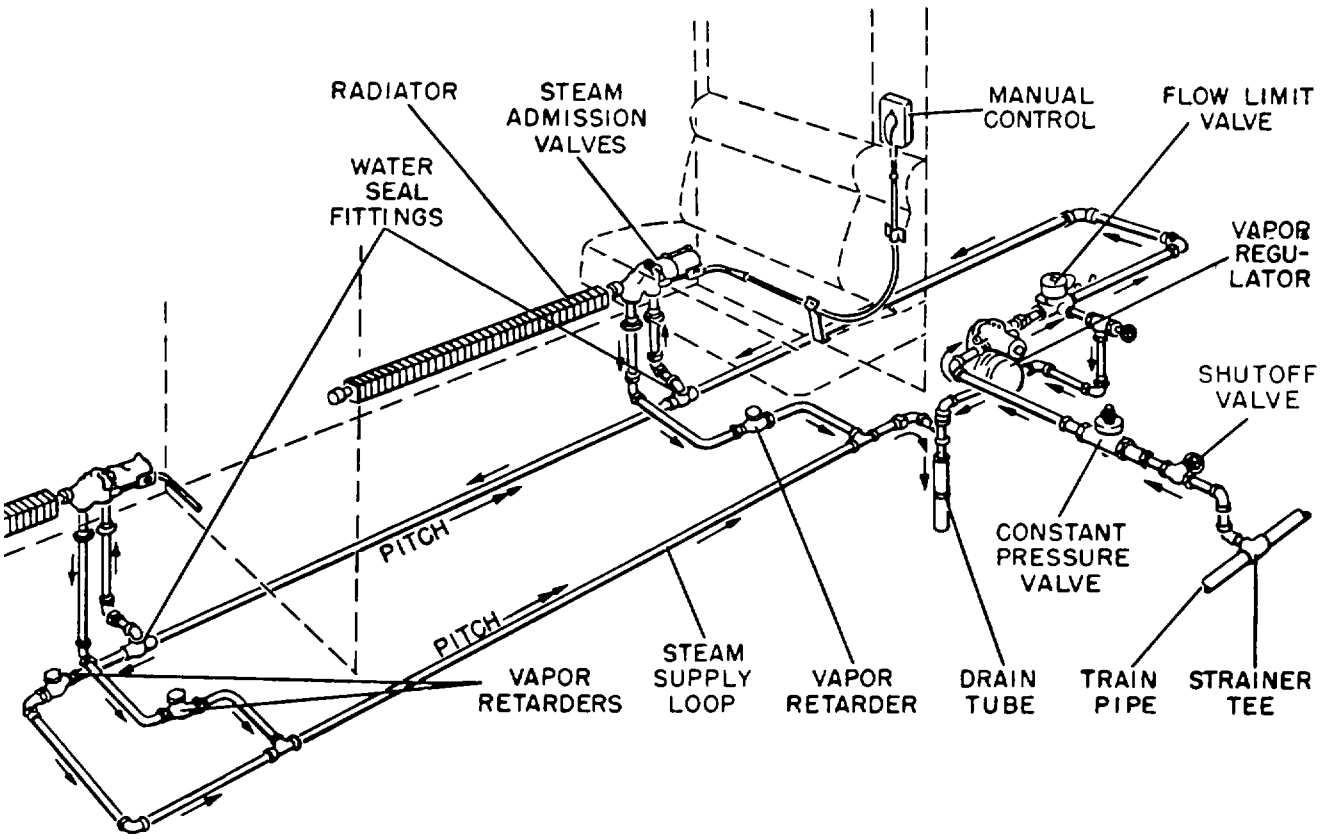


Figure 11-4. Zone system of car heating.

b. Essentially, the vapor zone heating system consists of one or more steam-supply loops of pipe underneath the car. Each loop is supplied by a single vapor regulator which releases live steam from the train pipe and converts it into vapor at 212° F. The steam-supply loop in turn furnishes steam (vapor) to two or more radiators, which are of the extended-surface, unit-fin type. Steam from the trainline is conducted from the trainline strainer tee (or cross) to the vapor regulator, where it is reduced to a pressure of 40 pounds. A shutoff and drain valve is placed ahead of the regulator to permit the steam to the vapor regulator and steam-supply loop to be shut off if required.

c. Each steam-supply loop is controlled in accordance with steam requirements by a flow valve incorporated in the regulator. The steam loop is divided into a feed portion and a return portion by a vapor loop retarder, which creates a reservoir of steam in the feed portion to insure an immediate delivery of steam to the radiator whenever the radiator steam-admission valves are open. The radiator condensate is piped to the return portion of the loop, and the condensate is open continually to the atmosphere through a return-pipe drain tube adjacent to the regulator. One type of automatic temperature-controlled vapor automatically operated vapor cutout valve is employed instead of the two manually operated valves previously discussed.

11-6. Direct Steam or Pressure Steam

In the direct steam system of car heating, the steam from the locomotive is carried directly to the radiators or heating pipes in the cars. The term is used to distinguish this system from those in which steam is vaporized before entering the heating system or is employed to heat the water which circulates in the radiators or heating pipes in the hot-water system of heating.

11-7. Electric Heat

On electric motorcars, the common method of heating is by use of resistance coils usually placed beneath the seats or along the walls. These coils become heated when electric current is passed through them, and the heat is transmitted to the surrounding air in the car. The coils are sectionalized so that varying degrees of heat may be obtained. On cars operated by direct current, it is customary to use the line voltage for heating. On alternating-current cars, a transformer is employed to cut down the voltage for heater use.

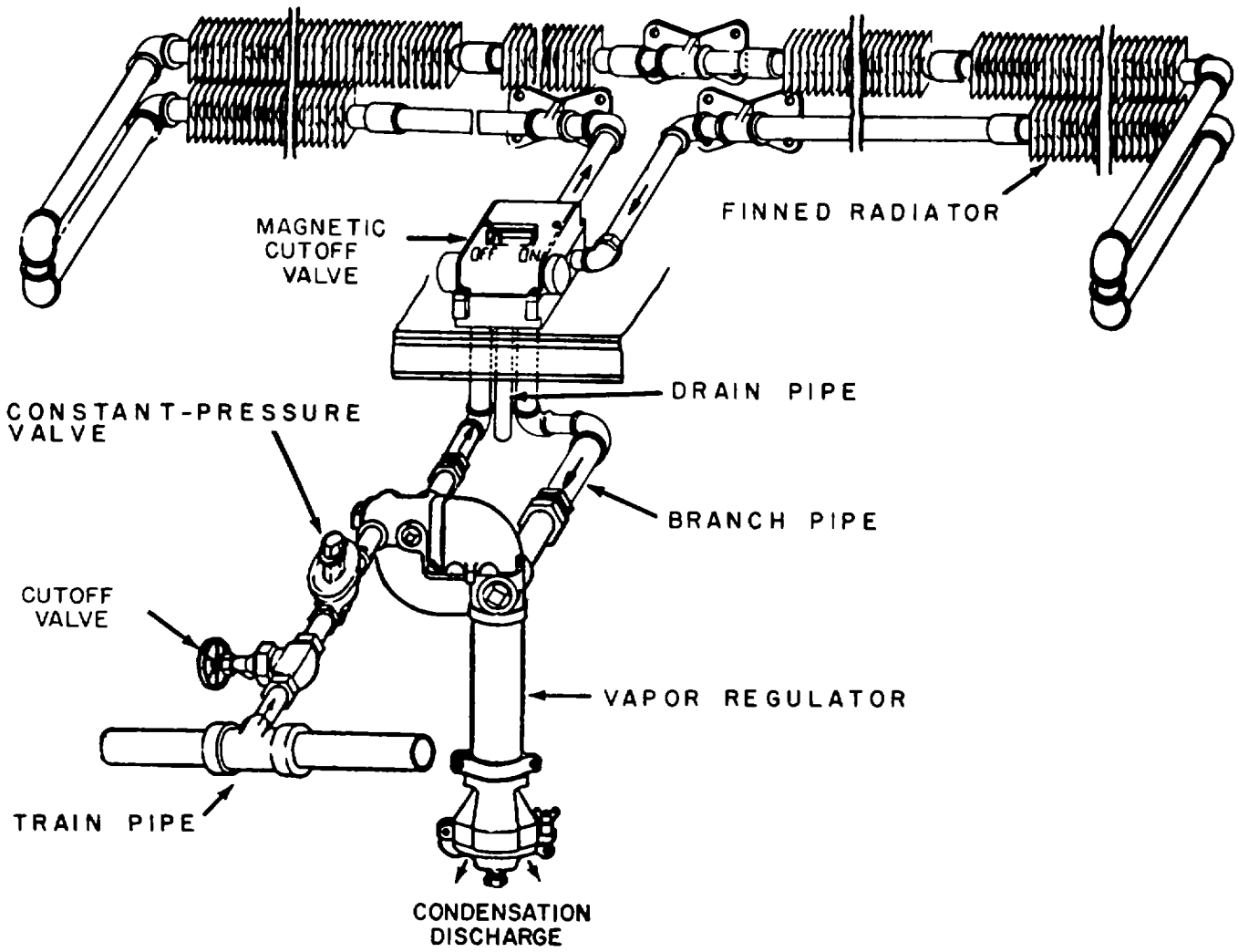


Figure 11-5. Automatic temperature-controlled vapor system.

11-8. Maintenance and Repair

a. General. The two essential factors of steamheat maintenance are the prevention of train delays through steam-heat failures and the provision of car comfort for passengers. This type of maintenance must often be performed during short layover periods at terminals. A maintenance program will include thorough inspection annually, preferably prior to the beginning of the heating season. The principal sources of trouble are discussed below.

b. End Train-Pipe Valves. The valve should be operated from the platform to see that the linkage is in operating condition and, also, from the weighted ball-type handle, to check the hold-open feature of the valve. In most cases, the valve stem will need repacking or the addition of a packing ring. The stem should have sufficient packing so that subsequent packing nut tightenings can be made by car inspectors as required. When the car is shopped, the valve should be disassembled and checked for wear, particularly the main valve and seat. The bleeder valve, pins, cams, and levers should be checked for wear upon reassembly; the valve should be tested under high-pressure steam for leaks and proper functioning.

c. Strainer (fig 11-4). The strainer, located in the trainline crosses and tees, should be removed and cleaned when a car is shopped. Normally, this is adequate attention.

d. Vapor Cutout and Drain Valve. The cutout and drain valve located in each branch pipe should not require maintenance if thoroughly overhauled when a car is shopped. If a constant steam leak exists at the drain port, it usually is indicative of a faulty back seat in the valve. This can be corrected by grinding the seat. This seat

should be tight when the valve is in open position.

e. Steam Couplers. If steam blows at the joint, it may indicate broken lugs, faulty gasket, gasket spring, or locking lever. Replace entire coupling only when necessary.

f. Constant Pressure Valve (fig 11-5). This valve should be removed and repaired annually using procedures as follows:

(1) Disassemble the valve, clean and inspect parts for wear.

(2) Replace any part showing excessive wear on any springs that have lost their tension.

(3) Inspect the diaphragm carefully, particularly at the edges where continual flexing occurs, as cracks develop in these areas.

(4) Check the needle valve assembly, assure that the stem is true, and the valve and seat are not scored.

(5) Replace the needle valve if it or the valve seat are scored or wiredrawn.

(6) Reassemble, adjust, and test the constant-pressure valve under live steam pressure.

g. Vapor Regulator (fig 11-4). Visual observation of vapor regulators is sufficient to insure proper functioning. Steam leaking through the regulator when the vapor valve is closed is an indication the valve is not seating properly. A worn valve seat or dirt between the valve and seat may cause this condition. A worn seat should be reground or replaced; dirt may be blown out by closing the shutoff valve ahead of the regulator for a few minutes, then opening it again. If steam blows from the drain tube, the bellows diaphragm may be damaged. Before each heating season the regulator should be tested under pressure. Assure that the operating rods are free in the guide ruts. Thorough biennial overhaul includes the following:

(1) Disassemble, clean, and inspect all parts for wear.

(2) Replace badly worn or damaged parts.

(3) Check spring tension and inspect the gaskets.

(4) Inspect the regulator valve, assembly, bellows packing assembly, and the main bellows.

(5) Reassemble the regulator and check on a steam line.

h. Steam Traps. Excessive steam blows may be eliminated by changing the position of the adjusting screw. A steam trap that cannot be properly adjusted should be disassembled and inspected In the following manner:

(1) Remove the strainer and disassemble the trap. Examine the spring seat, disk, diaphragm, and strainer. Replace any defective parts.

(2) Test diaphragms before installation. If the diaphragm is expanded too much, it will not return to its normal fully contracted form when cool. Place the diaphragm in a holding fixture and submerge in water at about 190°F. Any leaks will be indicated by rising bubbles. A leaky diaphragm must be discarded; no attempt will be made to refill or repair it. After the test, submerge the diaphragm in cold water to contract it, then remove it from the holding fixture.

(3) Reassemble the trap. Check to see the adjusting screw, pins, and cotters are in good condition. Test the trap on a steam line at about 55 psi. Regulate the adjusting screw and observe for excessive steam blows.

i. Flow Limit Valve (fig 11-4). These valves should be checked and repaired annually, prior to the heating season, using the following procedure:

(1) Disassemble the valve and inspect the inlet valve assembly.

(2) Thoroughly clean the inlet valve assembly, particularly the strainer. Assure that the stem is free and that the valve and seat are not seated or worn.

(3) If the inlet valve will not seat tightly, replace the inlet valve assembly and inspect the 'gasket under the cap to see that the body of the flow limit valve is steamtight.

(4) Reassemble the valve and put it on a low-pressure steam line to determine the pressure at which the valve opens.

(5) If it does not open at the correct pressure, replace the spring.

j. Vapor Retarder (fig 11-4). A steam blow from the outer drain tube of a regulator indicates a faulty vapor retarder. Vapor retarders should be disassembled, cleaned, and inspected at least every 2 years, as follows:

(1) Test the thermostatic bellows for leaks by placing it in a holding fixture and submerging in boiling water. Do not submerge except in a fixture, as an over-expanded bellows will not return to its normally fully contracted form. Leaks in the bellows will be indicated by bubbles rising In the water. Leaky bellows must be discarded and replaced.

(2) Contract the bellows by submerging in cold water. Reassemble the vapor retarder; assure that the cap is steamtight. If the retarder is fitted

with a gasket under the cap, see that the gasket is in good condition and properly seated. Renew the gasket if required.

k. Solenoid Steam Admission Valves (fig 114). It is essential that the wings and bodies be cleaned thoroughly when repairing the valve. The inside of the valve body can be cleaned without removing it from the car. When reassembling the valve, care must be exercised in the alinement of parts. With a thorough cleaning and proper assembly, these valves should operate between shopping periods with little attention other than an occasional check for free operation. In some valves of the cutout type, the valves controlling the floor-heat radiation normally are open and are closed electrically as are the valves controlling steam to overhead radiators. During scheduled maintenance, the needle inlet valve should be replaced if the seat is badly wiredrawn, or a sticking valve will result.

l. Terminal Tests. Steam-heat equipment will be tested in car yards to determine if in proper operating condition, prior to placing passenger type cars so equipped into train service. The following procedures should be followed:

(1) Place a "dummy" coupling on one end, and connect the car to the yard steam supply line at the other end.

(2) Place a steam pressure of 50 pounds on the line.

(3) Check all shutoff valves and see that they are open.

(4) Close all floor and overhead admission valves.

(5) Inspect all regulators to determine that they do not have a continuous steam blow.

(6) Inspect all conduits, end valves and branch piping for leaks.

(7) Move admission valves to the "on" position; see that a complete heating circuit is made in all coils.

(8) On vapor loop equipment, test the loop by closing all admission valves and checking all shutoff valves to determine that they are in ,"open" position. If there is a slight blow at the regulator, it indicates a faulty loop retarder. If a heavy steam blow is noted, it indicates a bad valve or bellows in the regulator.

(9) Open each admission valve separately and check for a blow at the regulator. If a blow occurs, it indicates a faulty retarder or a dirty seat in that particular coil.

CHAPTER 12

AIR CONDITIONING

12-1. General

Three types of air-conditioning systems have been developed for use on railway passenger equipment: the ice-activated, the steam-ejector, and the mechanical-compression types. In the ice-activated system, cooling is accomplished by bringing the air to be cooled in contact with coils through which cold water is pumped. Mechanical refrigeration is not used in this system In the steam-ejector system, water, the refrigerating system, is evaporated rapidly in a vacuum to produce the cooling effect. Unevaporated water which is cooled as a result of evaporation is circulated through the cooling coil. These systems are largely obsolete, and only the mechanical-compression type is discussed in this manual (fig 12-1). Any military passenger equipment, such as ambulance cars, required to be air conditioned would be equipped with this type of air-conditioning system. The Surgeon General in the continental United States (CONUS) or the theater surgeon in oversea areas would probably prescribe conditions when excessive heat and humidity require air conditioning of rail equipment.

12-2. Mechanical-Compression System

Practically all the mechanical-compression systems now in use employ Freon (dichlorodifluoro-methane) as a refrigerant. The operation of the mechanical-compression system is as follows: the refrigerant in a liquid state and at high pressure in a receiver or storage reservoir is forced by its pressure through an expansion valve. This valve controls the flow of the liquid-refrigerant from the high-pressure receiver to the air-cooling coil or refrigerating evaporator where a lower pressure exists. Because of the reduction in pressure, a portion of the refrigerant evaporates, thereby lowering the temperature. The low temperature refrigerant in flowing through the air-cooling coil absorbs heat from the air passing over the coil. This absorption of heat vaporizes the refrigerant. The refrigerant vapor flows to the suction side of the refrigerating compressor where it is compressed and its temperature increased. The high-pressure, high-temperature refrigerant vapor is discharged from the compressor into the refrigerating condenser, or heat exchanger, where heat is transferred from the refrigerant to the cooling medium passing over the condenser coils. The cooling medium is either outside air or a combination of air and water. Thus, the refrigerant is condensed to a liquid state. The liquid refrigerant at high pressure flows from the refrigerating condenser into the storage reservoir, after which the cycle is repeated. Diagram of one kind of mechanical-compression system is shown in figure 12-1.

12-3. Control Equipment

a. General. Pneumatic-electric temperature control is based on the use of compressed air and electric motors operated through accurately calibrated thermostats. The latter selects the proper coolness, heat, and humidity required by inside and outside conditions. Whether air conditioning depends upon a single thermostat operating a damper motor or upon a more elaborate system with compensated temperature and humidity controls, the pneumatic-electric system can be used to control it.

b. Components. The system consists of the following parts:

(1) A main thermostat, subject to changes in temperature inside the car.

(2) An inside or humidity compensator which is exposed to the same temperature as the main thermostat and an outside compensator which is exposed to the outdoor temperature in the air intake.

(3) A parking thermostat to control temperatures when the car is in the yard.

(4) Damper and valve motors, controlled by the main thermostat.

(5) A closed system of piping connected with the compressed-air system of the train, supplemented by a storage cell of compressed air or by an air pump on the underframe.

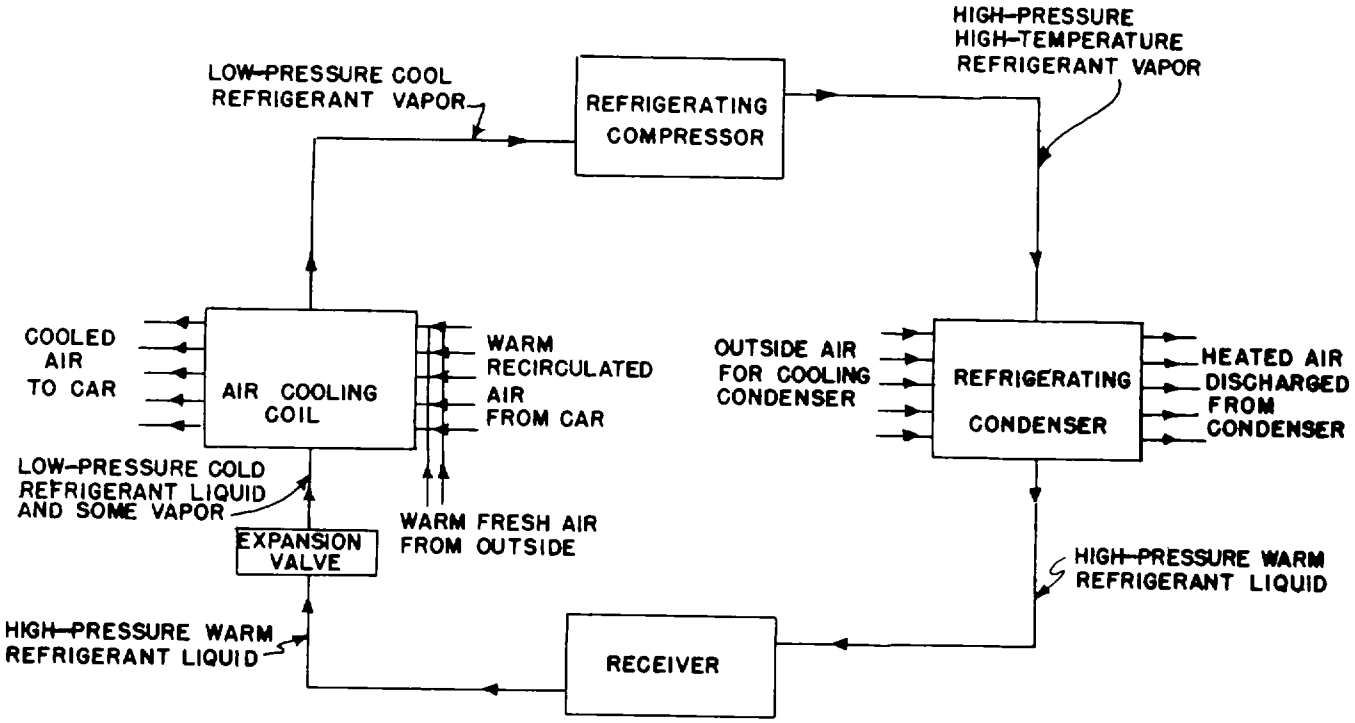


Figure 12-1. Flow diagram for mechanical-compression system.

(6) A control panel with gages, switches, reducing valves, pilot lights, and other devices for checking operation of the air conditioning when the car is in service and for checking replacements and repairs when the car is out for maintenance. Most elaborate systems use a series of thermostats, gaged to meet the varying requirements of heating, cooling, and humidifying the air.

12-4. Maintenance and Repair

a. General. A definite program of inspection and maintenance is essential to the operation of air-conditioning equipment on railway passenger cars. Commercial railroads have found by experience this maintenance program is divided into three general categories. The railroad designation and its military equivalent are: daily or end-of-trip maintenance (organizational), semimonthly (organizational-direct support), and annual equipment overhaul (general support-depot) In commercial railroad practice, this is flexible and is changed as necessary to meet the requirements of the particular service in which the equipment is placed. Maintenance procedures for various components are discussed below.

b. Condensing Unit. The coil assemblies should be inspected periodically and the framed surfaces cleaned with compressed air. Accumulated cinders and dirt should be cleaned from the framework. Supporting bolts should be checked to assure they are drawn up tight, with the nuts locked in place.

c. Compressor. Surface dust accumulations will be blown off with compressed air at the periodic inspections. An oily dirt accumulation indicates leaks which should be located and corrected. All nuts will be tightened. Check of compressor speed will indicate any belt slippage. The correct compressor speed is 511 rpm for 6-ton equipment and 382 rpm for 5-ton equipment. The corresponding motor speeds are 1,750 rpm and 1,450 rpm respectively. Direction of rotation of the compressor is clockwise when facing the flywheel end.

d. Belt Adjustment. After loosening the motor supporting bolts, adjust the belt tension by shifting the motor in its slotted supports by means of the adjuster screws. When belt adjustment is necessary and until the initial stretch is taken up, the fan shroud on the movable back half of the back cover should be moved with the motor so that the fan shift will always be centrally within the shroud. Proper belt tension will be

obtained when a pressure of 10 to 15 pounds per belt, applied midway between the compressor and motor pulleys, will depress a single belt 1 inch. More sag than this shows too little tension and will cause belt slippage Greater tension increases belt stretch and shortens wearing life. The faces of the compressor and motor pulleys should be in alinement Check this after belt adjustments The face of the motor pulley must not project out past the plane of the face of the compressor pulley and should not be more than 1/16 inch behind this plane.

e. Lubrication. The compressor flywheel bearing is wick-fed lubricated from an oil reservoir in the crankcase under the bearing. This reservoir should be drained, flushed, and refilled monthly while air conditioning is in use. Access to the reservoir is through oil filling plugs on each side and in the bottom. The reservoir holds one-fourth inch and should be filled to the level of the filling hole. All other lubricated surfaces are fed from the oil pump in the compressor crankcase. The crankcase holds 12 pints of oil, filled to one-eighth inch from the top of the sight gage. The oil level must be checked after one-half hour of normal operation and immediately upon shutting off the compressor. The accumulation of Freon in the crankcase when the equipment is idle results in a fictitious oil level indication. This may cause violet boiling of the crankcase mixture when the pressure is reduced while pumping down This result in oil being carried into the cylinder and pumped into the system, lowering the oil level in the crankcase. The need for operating the equipment for some time before obtaining the true oil level is obvious. Oil must be added when the observed true level is within 1/8 inch of the bottom of the sight gage.

f. Refilling Crankcase. To add oil to the crankcase, proceed as follows (compressor crankcase oil should be kept in, clean closed containers and not be left open to the atmosphere any more than absolutely necessary):

(1) Place sufficient quantity of #24 or #25 refrigerating machine oil in a clean container.

(2) Remove the plug from the oil charging valve on the side of the crankcase.

(3) Screw a short nipple into the plug hole and attach a clean rubber hose or copper tube to the nipple.

(4) Submerge the fuel end of the hose (or tube) well down into the oil in the container and open the valve very slightly to purge the hose.

(5) Close the receiver shutoff valve and pump the system down until the low-pressure gage shows a slight vacuum.

(6) Open the oil filling valve slightly and permit oil to enter.

(7) From observation of the true oil level, estimate the quantity of oil required to fill the level to within 1/8 inch of the top of the sight gage and admit only this amount.

(8) If the true level cannot be determined because of being below the sight gage, admit 2 pints at a time, operating the equipment after each addition until the level can be determined. Then proceed as outlined above, falling to the desired level.

(9) Close the oil filling valve and replace the plug in the valve outlet; open the receiver shutoff valve.

Caution: **Never let the oil level in the container fall below the mouth of the tube when adding oil, as this would allow the compressor to suck in air.**

g. Refrigerant Troubleshooting. The diagnosis of trouble in the refrigerating system is a problem of cause and effect. The troubleshooter must have accurate gages and thermometers, otherwise misleading reading will be taken. Care must be taken in handling Freon since it has no odor and gives no warning of leaks. Car repairmen must wear goggles when working on parts from which refrigerant may be liberated. If liquid refrigerant (Freon) gets into the eyes, the injured person should be rushed to a medical officer for attention. The following procedure is prescribed in the interest of safety:

(1) Open the compressor control switch before starting work around the electrical parts or rotating parts.

(2) When the refrigerant vapor is pumped from the compressor crankcase, follow the intermittent operation to avoid pumping over excess amounts of oil, and building up of pressure in the crankcase. This pressure is caused by the release of refrigerant dissolved in the oil and results in blowing out of refrigerant vapor and oil when the crankcase is opened.

(3) Permit the evaporator unit to warm up to room temperature before pumping down the refrigerant. This precludes escape of any liquid refrigerant left when the evaporator is disconnected.

(4) Check the oil level in the compressor after replacing major parts, which may contain

oil, or after any change resulting in the loss of oil Add more oil if required.

(5) Check that all shutoff valves are in open position before starting equipment. This is particularly applicable to the compressor discharge shutoff valve, as the compressor will be damaged if it is operated with these valves closed.

(6) Service valves to be left open will be turned back slightly from the wide open position to insure that they will not bind in the open, or back seated position.

(7) Purge all parts previously opened to the atmosphere to remove all air by releasing some refrigerant.

(8) Check thoroughly for leaks at any point where repairs have been made.

(9) Seal all valve connection plugs by applying Clyptol to the slug threads. Do not apply it to the female threads.

(10) Use new gaskets when replacing parts requiring gaskets. Be sure all parts are removed from the surfaces before new gaskets are applied.

h. Winter Preparation. When the use of air conditioning equipment is discontinued for the winter months, the following precautions should be taken:

(1) Close the receiver shutoff valve and pump the refrigerant into the receiver, stopping the operation as soon as 5 pounds suction pressure is reached.

(2) Leave the crankcase with this positive pressure imposed to help prevent air and moisture from being drawn into the system at the shaft seal.

(3) Close the condenser shutoff valve, the compressor suction cutoff valve, and the compressor discharge shutoff valve. Leave all other valves in normal operating position.

(4) Remove the compressor driving belts, keeping each set intact and store them in a clean dry place.

(5) Cover the unpainted surfaces of the compressor flywheel pulley and motor pulley with rust preventive.

(6) Remove the d.c. compressor motor fuse.

(7) Place the narrow canvas belt provided with the equipment over the fan openings in the middle of the motor. The ends of the belt should be at the bottom and the belt tied tightly around the motor.

(8) Place the canvas hood over the pulley and the commutator end of the motor. The drawstring at the end of the hood will be at the outer end of the motor frame, while the drawstring placed through the ears of extensions of the hood will be behind the rear row of pole piece bolts. Both should be tied tightly in place. Enclosing covers of tin should be placed over the condenser openings on both ends of the unit and the condenser fan opening in the back cover of the unit.

(9) Shut off the air pressure to the spray water supply tank where a separate tank is provided, and drain the system. If separate water tanks are not provided, close the valve in the water line leaving the tank.

(10) Clean the strainers in the water line of sediment and dirt.

(11) Open the petcocks in the spray nozzle piping to drain all the water out, then close petcocks and blow down openings to prevent the entrance of dirt and foreign matter during the winter period.

i. Summer Preparation. Before operation of the air-conditioning equipment after the winter shutdown period, take the following actions:

(1) Remove all winter hoods and covers.

(2) Inspect the apparatus for cleanliness and blow out any dirt that may have collected.

(3) Examine all bearings; add any lubrication required.

(4) Tighten all bolted joints in the wiring.

(5) Inspect all contacts in the control for proper condition.

(6) Check brushes in the motor for freedom and spring pressure.

(7) Remove the slushing compounding from the compressor flywheel and motor pulley and replace the belts, keeping each set of belts intact. Check belt tension and the proper alinement of pulleys.

(8) Loosen or remove both purge plugs, and note whether or not any Freon is purged from the compressor.

(9) Operate the compressor by hand to pull a vacuum on the crankcase; then open the receiver shutoff valve and the compressor suction shutoff valve. This will permit Freon to flow from the receiver to the compressor crankcase. Again rotate the compressor by hand to purge any air that has leaked into the crankcase.

(10) Replace the purge plugs and open the compressor discharge cutoff valves and condenser shutoff valves. Check all valves for operating positioning, and replace the d.c. compressor motor fuse.

(11) Operate the equipment for a few minutes and check oil level in the compressor crankcase. Operate for an hour making checks at intervals on refrigerant and oil levels.

(12) Check all joints for Freon leaks.

PART FOUR

PAINTING, LETTERING, AND NUMBERING OF RAILWAY CARS

CHAPTER 13

GENERAL

13-1. Colors

Railway equipment will be repainted only when required for preservation purposes and not merely for the purpose of beautification or of changing color, unless considered necessary for safety or security purposes by the responsible commander. Except where otherwise specified or directed, railway rolling stock in theaters of operations will be painted lusterless olive drab X34087. In the continental United States (CONUS), all exposed exterior painted surfaces on freight, passenger, hospital, kitchen, and caboose or guard cars, will be painted gloss olive green 14064. All exposed exterior surfaces on gondola, hopper, and tank cars, will be painted gloss black 17038. All painting and marking will be in accordance with AR 746-1, and paint standards contained in MIL-P-3320. For painting in theaters of operations, all exterior finish coats will be olive drab semigloss 24087. A complete list of paints authorized for use for railway freight and passenger cars is given in table 13-1.

Table 13-1. Authorized Materials

Material	Number
Aluminum gloss	17178
Black, gloss	1703,8
Black, semigloss	27038
Black, lusterless	37038
Blue, gloss	15044
Blue, semigloss	25053
Buff, gloss	10371
Gray, gloss	16187
Gray, semigloss	26152, 26492, 26307
Gray, lusterless	X14050, 14062, 14110
Green, gloss	36118, 26270
Green, semigloss	24410, 24260
Olive drab, gloss	14087
Olive drab, semigloss	24087
Olive drab, lusterless	34087

Table 13-1 Authorized Materials-Continued

Material	Number
Olive green, gloss	14064
Red, gloss	11136
White, gloss	17875
White, semigloss	37875
White, lusterless	13538
Yellow, gloss	33538
Yellow, lusterless	33538

13-2. Safety

a. General. As a matter of Army policy, safety markings on railroad equipment will be applied in CONUS only. Personnel engaged in painting operations must be cautioned by supervisors to exercise caution in handling paints. Poisonous compounds are often used in paints. Personnel working with paints should wash hands and face carefully before handling food, and keep cuts or wounds free of painting materials. Many thinners create dangerous fumes, and personnel can be seriously injured through inhalation. Most paint materials are flammable, and use of matches, open flames, or smoking should be avoided in paint areas.

b. Ventilation

(1) When painting the inside of any equipment having only a small opening to the outer air, an air hose or electric blower will be used to force a continuous flow of fresh air into the enclosed space. Two persons will work together inside, while a third person remains outside near the opening to insure their safety. Personnel working on the interior will emerge at 15-minute intervals for fresh air.

(2) If it is at all practicable, cars will be painted in the open air.

c. Safety Precautions

(1) Respirators will be worn during all spray painting operations.

(2) Preparations containing benzol will not be applied by spraying Inhaling benzol fumes is extremely injurious to health.

(3) Cover lugs of the pressure-feed paint tank will not be loosened unless it is certain that pressure in the container has been released.

(4) Pressure-feed paint-tank safety valves will be tested regularly.

(5) Rubber gloves should be worn when !handling sealer or acid solvents.

d. Causes and Prevention of Fire

(1) Fires in spray booths and other parts of the paint shop usually are the result of one of the following causes: broken electric lamps and other electrical defects; cleaning of fans, motors, and interior of booths with highly flammable solvents; accumulated deposits in booths, tubes, and vent pipes, resulting from failure to clean them frequently; defective fans and motors used to ventilate the booths and paint shops; poorly designed and unguarded vent tubes; and static electricity.

(2) It is very important that the paint shop be kept clean Accumulated spray dust in booths and in cracks and corners of the paint shop is particularly dangerous, because it ignites readily from spontaneous combustion. All dust spray must be scraped from the walls, spray booths, corners, and any other places in which it accumulates. Special nonsparking bronze scrapers will be used for this purpose. Before scrapings are discarded, they must be soaked thoroughly with water.

(3) Flammable solvents are never used to clean the walls of the paint shop.

(4) Mist which comes from a spray gun is highly flammable and a spark may ignite it. Smoking; the use of open flame lights, space heaters, and processing equipment; the use of resistance-type electrical heaters; and the use of electric motors, switches, fuses, fuse boxes, and wiring not approved for use in atmosphere containing flammable vapors, are prohibited in the plant shop.

(5) Only vapor-proof lamps will be used where spraying is being done.

(6) Rags and waste which are soaked with paint and oil are fire hazards, and will be placed in standard, self-closing metal cans having legs 'at least 4 inches high to provide space for air circulation. Cans will be emptied at the end of each working day and contents removed to a safe area for destruction. Trash and rubbish will be placed in covered metal containers which will be emptied daily and their contents destroyed or stored in a safety isolated vault.

(7) The main stock of solvents, paints, and other flammable materials will be stored outside the paint shop in a separate enclosure. Cans containing paints, thinners, and other paint materials will be covered tightly before being stored or put away for the night. The precautions outlined in TM 10-1101, for the storage of petroleum, will also be followed for paint, thinners, etc.

(8) Empty drums or other containers in which solvents, thinners, and similar other materials have been shipped are potential hazards, since they often contain enough vaporized material of a flammable nature to cause an explosion. Heat or flame must never be applied to such drums or cans unless they are first steamed out thoroughly, filled with water, and Inspected to insure that all traces of odor and of paint material are removed.

e. Protection While Sandblasting

(1) Operators will be equipped with proper masks, gloves, and canvas aprons to guard against injury. It will be the responsibility of the officer in charge to see that these are provided and used.

(2) Sandblasting will not be performed in closed areas unless adequate ventilation is provided, and additional personnel are stationed outside to protect the workers.

(3) Whenever possible, a shed or building at least 100 feet away from any other shop building will be used for sandblasting. When it is necessary to sandblast in the open, the operation will be placed at a sufficient distance to prevent sand, dust, or other particles from getting into nearby machinery or other equipment.

CHAPTER 14

PAINTING OF RAILWAY FREIGHT AND PASSENGER CARS

Section I. GENERAL

14-1. Painting Policy

Railway freight and passenger cars normally will be repainted completely during depot maintenance. At other times, spot painting will be done as a matter of preventive maintenance if the painted surface has deteriorated to such an extent that rusting or peeling is evident. All rolling stock will be inspected periodically to locate any surfaces on which paint has blistered, peeled, or otherwise deteriorated. Timely spot painting will insure suitable protective coating on wood and metal surfaces, and often eliminate the need for complete repainting of equipment The car repair shop supervisor will determine the need for repainting, and whether to paint over old surfaces or remove old coatings. Exterior surfaces are exposed to rain, snow, sleet, hail, corrosive gases, heat, intense sunlight, wind-driven grit, and other destructive influences. A good paint job depends upon weather conditions, the selection of a suitable paint, proper preparation of the surface to be painted, and the method of application. A film of sufficient thickness to cover and protect the surface will be used.

14-2. Preparation for Painting

All surfaces will be cleaned of loose paint, dirt, scale, grease, and rust before they are painted. It is preferable to sandblast cars having steel exteriors or interior finishes, when the undercoats require renewing. This normally is done in a sandblast shed (para 13-2e), where the old coatings are removed and a priming coat is applied Sandblasting of the thin inner sheets, such as are used for interior finish on passenger equipment, may be satisfactorily accomplished with reduced air pressure, and with sand that has been previously used on the heavy exterior sheets and has lost some of its sharpness The sandblasting and priming of new sheets to be used in car repairs frequently is done before the sheets are used. The manner in which either freight or passenger cars are prepared for painting depends upon the material of which the car is constructed, and upon the type of paint applied. Freight cars usually are prepared by sandblasting, scraping, wire brushing, burning off old paint, or chemical paint stripping. Regardless of how the paint is removed and how the freight car is readied for painting, the first coat should be applied as soon after preparation as possible. This prevents rusting on steel materials and water-soaking of wooden materials involved. On passenger cars, the paint or varnish is removed when necessary by paint or varnish remover. Paint is removed from the car body while the car is in the repair shop, and from trim in the shop where it is being reconditioned. Before being repainted or revarnished, the surfaces are cleaned with naphtha or similar material to remove all traces of the remover. Fire and safety precautions will be taken when using naphtha.

14-3. Painting Techniques

a. General. Paint will be applied with care and under competent supervision. For the protection of the surface, the first or priming coat is of the greatest importance, since corrosion or rot may spread rapidly under the paint film if the primer is not properly applied.

(1) Steel surfaces, other than welded or hot-riveted surfaces which are inaccessible after assembly, will be given one coat of chromate primer before assembly. Wood surfaces which are inaccessible after assembly will be given one coat of synthetic primer before assembly.

(2) Wood or steel sills, braces, posts, stringers, etc., which are exposed during repairs to equipment, will be brush painted or sprayed with one coat of chromate primer.

(3) Paint applied to trucks and component parts will be thinned sufficiently so that detection of cracks or other flaws is not prevented. Wheels, axles, and parts contained in the journal box will not be painted.

b. Spray Gun Application. Hose of adequate inside diameter must be used with paint spray equipment. In a great many instances, malfunction of the spray gun is due to an insufficient supply of air at the gun. This condition usually is caused by the use of hose of improper size. A drop in pressure occurs whenever compressed air is transmitted. Table 14-1 Indicates the air pressure in pounds per square inch (psi) of a spray gun equipped with an air cap consuming approximately 12 cubic feet of air per minute at 60 pounds pressure.

Table 14-1. Spray Gun Air Pressures

Air pressure at source (psi)	Air pressure at spray gun (psi)					
	5-foot hose	10-foot hose	15-foot hose	20-foot hose	25-foot hose	50-foot hose
40*	34	32	30 1/2	29	27 1/4	16
50*	42 1/2	40	38	36	34	22
60*	51	47 1/2	45 1/2	43 1/4	41	29
70*	59 1/4	55 1/2	53	50 1/2	47 1/2	36
80*	67 3/4	63 1/2	60 1/2	57 1/2	54 1/2	43
90*	76	71 1/4	68	64 3/4	61	50 1/2
40**	37 3/4	37 1/4	36 3/4	36 1/2	36	31 1/2
50**	47	46 1/2	46	45 1/2	45	40
60**	56 1/4	55 1/2	55	54 1/2	54	49 1/2
70**	65 1/2	64 3/4	64	63 1/4	62 3/4	57
80**	74 1/2	73 3/4	73	72	71 1/4	65 1/2
90**	83 1/2	82 1/2	81 1/2	80 1/2	80	74

*Airhose 1/4 inch inside diameter.

**Airhose 5/16 inch inside diameter.

Section II. FREIGHT CARS

14-4. General

a. Surfaces will be prepared for painting as outlined in MILP-3320 (para 14-2).

b. All sections of new wood, except those to be varnished, will be coated with wood preservative.

c. Parts exposed during repair parts inaccessible after assembly will be coated as outlined in paragraph 14-3.

d. Wheels, axles, couplers, and parts contained in the journal box will not be painted.

e. On both all-steel and outside metal roofs, care will be taken to cover with the required number of coats all parts which are folded over or otherwise concealed. The finish coat on that portion of roof under the running board is to be applied before running board saddles are installed. Running board saddles will receive one coat of synthetic primer and two coats of olive green enamel before being applied to cars.

f. When painting cabooses, measures will be taken to prevent paint from damaging signal or brake valves, lights, gages, first-aid cabinets, firefighting equipment, hardware, door and window glasses, and lavatories.

14-5. Application of Materials

The type and number of primer and finish coats to be applied to the various portions of freight cars and cabooses is shown in table 14-2.

Table 14-2. Painting System for Freight Cars and Cabooses

Type of car	Area of car	Portion to be painted	Primer		Finish coat	
			Number of coats	Type and color	Number of coats	Type and color
1. Boxcar	*a.* Interior	(1) Exposed surfaces of doors and frames.	1	TT–E–485, Type II, enamel, OD, X24087, 1.0 to 1.5 mils.	2	TT–E–489, class A, Army olive green enamel 14064, 0.8 to 1.2 mils each coat.
	(Metallic roofs)	(2) Underside Galvanized surfaces.	None	None		None.
		Ferrous surfaces	1	TT–P–86, Type III Red lead.	1	TT–P–86, Type III Red lead.
	(Metal surfaces)	(3) Behind side and end linings.	1	TT–E–485, Type II, enamel, OD X24087, 1.0 to 1.5 mils.	1	MIL–C–13950 coating compound, bitum. 1/16 inch thick, black.
	(Wood flooring)	(4) All	None	None	None	None.
	(Steel flooring)	(5) All	None	None	1	Nonskid composition over entire surface.
	b. Exterior	(1) All exposed surfaces including trucks and components.	1	TT–E–485, Type II, enamel, OD, X24087, 1.0 to 1.5 mils.	2	TT–E–489, Army olive green enamel, 14064, 0.8 to 1.2 mils each coat.
	(Metallic roofs)	(2) Galvanized surfaces.	1	MIL–E–15929, Vinyl-red lead, 1.0 to 1.5 mils.	3	MIL–E–15932, Vinyl-alkyd, gloss black, 0.8 to 1.2 mils each coat.
		(3) Steel roofs	1	MIL–P–15929, Vinyl-red lead, 1.0 to 1.5 mils.	3	MIL–E–15932, Vinyl-alkyd, gloss black, 0.8 to 1.2 mils each coat
	c. (Underframes)	All	1	MIL–P–15929, Vinyl-red lead, 1.0 to 1.5 mils.	3	MIL–P–15932, Vinyl-alkyd, gloss black, 0.8 to 1.2 mils each coat.
2. Caboose	*a.* Interior	(1) Exposed metal surfaces.	1	TT–E–485, Type II, enamel, OD, X24087, 1.0 to 1.5 mils, class A.	2	TT–E–529, Light green enamel, class A, 24533, 0.8 to 1.2 mils each coat.

Table 14-2. Painting System for Freight Cars and Cabooses-Continued

Type of car	Area of car	Portion to be painted	Primer		Finish coat	
			Number of coats	Type and color	Number of coats	Type and color
		(2) Exposed wood surfaces.	1	TT–P–636, Synthetic primer.	2	TT–E–529, Light green enamel, class A, 24533, each coat, 0.8 to 1.2 mils.
		(3) Exposed surfaces of wood flooring.	1	TT–P–636, Synthetic primer.	2	MIL–E–18214, dark green deck paint each coat, 0.8 to 1.2 mils.
		(4) All metal surfaces behind ceiling, flooring and lining.	1	TT–E–485, Type II enamel, OD, X24087, 1.0 to 1.5 mils.	1	MIL–C–13950 coating compound, bitum. 1/16 inch thick, black.
	b. Exterior (Metallic roofs)	(1) Galvanized surfaces.	1	MIL–P–15929 Vinyl-red lead, 1.0 to 1.5 mils.	3	MIL–E–15932, Vinyl-alkyd, gloss black, 0.8 to 1.2 mils each coat.
		(2) Steel roofs	1	MIL–P–15929, Vinyl-red lead, 1.0 to 1.5 mils.	3	MIL–E–15932, Vinyl-alkyd, gloss black, 0.8 to 1.2 mils each coat.
	(Underframes)	All	1	MIL–P–15929, Vinyl-red lead, 1.0 to 1.5 mils.	3	MIL–E–15932, Vinyl-alkyd, gloss black, 0.8 to 1.2 mils each coat.
	(Handholds and sill steps)	All	1	TT–E–485, Type II enamel, OD, X24087, 1.0 to 1.5 mils.	2	TT–E–489, Yellow enamel, class A, 13538, 0.8 to 1.2 mils each coat.
		All other exposed surfaces including trucks and components.	1	TT–E–485, Type II, enamel, OD, X24087, 1.0 to 1.5 mils.	2	TT–E–489, Olive green enamel, class A, 13538, 0.8 to 1.2 mils each coat.
3. Flatcar	*a.* All exterior	(1) Exposed surface wood flooring.		None		None.
		(2) Steel flooring		None	1	Nonskid composition over entire surface.

Table 14-2. Painting System for Freight Cars and Cabooses Continued

Type of car	Area of car	Portion to be painted	Primer		Finish coat	
			Number of coats	Type and color	Number of coats	Type and color
		(3) Exposed ends, sides, truck and components.	1	TT–E–485, Type II, enamel, OD, X24087, 1.0 to 1.5 mils.	1	TT–E–527, Army Olive drab lusterless enamel, X24087, 0.8 to 1.2 mil each coat.
	b. Underframes	All	1	Vinyl-red lead, MIL–P–15929, 1.0 to 1.5 mils.	3	MIL–E–15932, Vinyl-alkyd, gloss black,. 0 8 to 1.2 mils each coat
4. Gondola car	*a.* Interior	(1) Exposed surfaces of wood flooring.		None		None.
		(2) Steel flooring	None	None	1	Nonskid composition covering entire surface 1/16 inch thick.
		(3) Exposed ferrous surfaces.	1	TT–P–86, Type III, red lead paint, 1.0 to 1.5 mils.	None	None.
	b. Exterior	Other exposed surfaces including truck and components.	1	TT–E–485, Type II enamel, OD, 1.0 to 1.5 mils.	2	TT–E–489, Army black enamel, 17038, 0.8 to 1.2 mils each coat.
	c. Underframes	All	1	MIL–P–15929 Vinyl-red lead, 1.0 to 1.5 mils.	3	MIL–E–15932, Vinyl-alkyd, gloss black, 0.8 to 1.2 mils, each coat.
5. Hopper car	*a.* Interior	All	1	MIL–P–15929, Vinyl-red lead, 1.0 to 1.5 mils.	3	MIL–E–15932, Vinyl-alkyd, gloss black, 0.8 to 1.2 mils, each coat.
	b. Exterior	Other exposed surfaces, including truck and components.	1	TT–E–485, enamel, OD, X24087, 1.0 to 1.5 mils.	2	TT–E–489, class A, Army black enamel, 17038, 0.8 to 1.2 mils, each coat.
	c. Underframes	All	1	MIL–P–15929, Vinyl-red lead, 1.0 to 1.5 mils.	2	MIL–E–15932, Vinyl-alkyd, gloss black, 0.8 to 1.2 mils, each coat.

Table 14-2. Painting System for Freight Cars and Caboose--Continued

Type of car	Area of car	Portion to be painted	Primer		Finish coat	
			Number of coats	Type and color	Number of coats	Type and color
6. Maintenance car	*a.* Interior	(1) Wood surfaces including flooring.	1	TT–P–636, Synthetic primer.	2	TT–E–489, class A, Army olive green enamel, 14061, 0.8 to 1.2 mils, each coat.
		(2) Metal surfaces	1	TT–E–485, enamel, OD, X24087, 1.0 to 1.5 mils.	2	TT–E–489, class A, Army olive green enamel, 14064, 0.8 to 1.2 mils, each coat.
		(3) Interior of battery box and blocking.	None	None	1	TT–V–51, Asphalt varnish (acid resistant) 2.3 to 2.8 mils.
		(4) Interior of all lockers.				
		(*a*) Steel	1	TT–E–485, enamel, OD, X24087, 1.0 to 1.5 mils.	1	TT–E–489, class A, Army olive green enamel, 15064, 0.8 to 1.2 mils.
		(*b*) Wood	1	TT–P–636, Synthetic primer.	1	TT–E–489, class A, Army olive green enamel 14064.
	b. Exterior	(1) Safety railing frame, sides and ends.	1	TT–E–485, enamel, OD, X24087, 1.0 to 1.5 mils.	2	TT–E–489, class A, yellow enamel, 13538, 0.8 to 1.2 mils, each coat.
		(2) Exposed surface of attached components, including trucks and components.	1	TT–E–485, enamel, OD, X24087, 1.0 to 1.5 mils.	2	TT–E–489, class A, Army olive green enamel, 14064, 0.8 to 1.2 mils, each coat.
	c. Underframes	All	1	MIL–P–15329, Vinyl-red lead, 1.0 to 1.5 mils.	3	MIL–E–15932, Vinyl-alkyd, gloss black, 0.8 to 1.2 mils, each coat.
7. Refrigerator car	*a.* Interior	(1) All exposed wooden surfaces, including floors.	None	None	2	MIL–V–1174, Spar varnish.

Table 14-2. Painting System for Freight Cars and Cabooses-Continued

Type of car	Area of car	Portion to be painted	Primer		Finish coat	
			Number of coats	Type and color	Number of coats	Type and color
		(2) Metal surfaces behind linings.	1	TT–E–485, enamel, OD, Type II, 24087, 1.0 to 1.5 mils.	None	None.
	b. Exterior	(1) Galvanized and steel roof panels.	1	TT–E–485, enamel, OD, Type II, 24087, 1.0 to 1.5 mils.	2	TT–P–320, Aluminum enamel, Type II, 0.8 to 1.2 mils, each coat.
		(2) Hatch covers	2	TT–P–86, red lead paint, Type III, 1.0 to 1.5 mils.	2	TT–P–320, Aluminum enamel, Type II, 0.8 to 1.2 mils, each coat.
	c. Underframes	All	1	MIL–P–15929, Vinyl-red lead, 1.0 to 1.5 mils.	3	MIL–E–15932, Vinyl-alkyd, gloss black, 0.8 to 1.2 mils, each coat.
	d. Other exposed surfaces.	Ladders, running boards, brake steps, trucks and components.	1	TT–E–485, enamel, OD, Type II, 24087, 1.0 to 1.5 mils.	2	TT–E–489, class A, Army olive green enamel, 14064, 0.8 to 1 2 mils, each coat.
8. Tank car	*a.* Interior	Surfaces of tank with lading as follows:	2		2	MIL–E–15145, Zinc dust paint, 1.2 to 1.6 mils, each coat.
		(1) Water	None	None	2	MIL–C–4556, QPL–4556, classes 2 and 3 or
		(2) Petroleum products.	None	None	1	MIL–P–23236, QPL–23236, film thickness in accordance with applicable specification.
		(3) Chemical products and other lading.	Paint shall conform to the requirements of the end item specification for the particular tank car.			
	b. Exterior	Inaccessible metal surfaces forming cavity between tank shell and jacket.	1	TT–E–485, enamel, OD, Type II, 24087, 1.0 to 1.5 mils.	None	None.

Table 14-2. Painting System for Freight Cars and Cabooses Continued

Type of car	Area of car	Portion to be painted	Primer		Finish coat	
			Number of coats	Type and color	Number of coats	Type and color
	c. Other exposed surfaces.	All metals, including trucks and components.	1	TT-E-485, enamel, OD, Type II, 24087, 1.0 to 1.5 mils.	3	TT-E-489, Army black enamel, class A, 17038, 0.8 to 1.2 mils, each coat.
	d. Underframes	All	1	MIL-P-15929, Vinyl-red lead, 1.0 to 1.5 mils.	2	MIL-E-15932, Vinyl-alkyd, gloss black, 0.8 to 1.2 mils, each coat.
	e. Shell surfaces of tank cars.	(1) Aluminum shell	1	TT-P-645, Zinc chromate, 1.0 to 1.5 mils.	2	TT-P-320, Aluminum enamel, Type II, class A, 0.8 to 1.2 mils, each coat.
		(2) Steel shell	1	TT-E-485, Enamel, OD, 1.0 to 1.5 mils.	2	TT-P-320, Aluminum enamel, Type II, class A, 0.8 to 1.2 mils, each coat.

Notes 1 Specifications given above are for US Army-owned cars, domestic service (in CONUS) only. Specifications for Air Force- and Navy-owned rolling stock and for painting *all* DOD-owned rail equipment in oversea service are contained in MIL-P-8320.

2. Aluminum enamel is prepared by mixing 16 ounces of aluminum paste (TT-P-320, Type II, class A) with 1 pint of turpentine and 1 gallon of varnish (TT-V-109).

3 Zinc dust paint shall be applied after all hydrostatic tests have been completed. Apply as follows:

Clean to bare metal and apply one coat. Circulate unheated air through tank for 12 hours and apply second coat. Again circulate unheated air through tank for 12 hours. Tanks shall be flushed twice with fresh water before being placed in service.

4. Paint applied to truck and components shall be so applied that the detection of cracks or other flaws is not prevented.

Section III. PASSENGER SERVICE CARS

14-6. General

Passenger, troop kitchen, guard, and Army Medical Department cars (ambulance and hospital cars) require more careful attention to painting than freight cars, in order to maintain standards of appearance, sanitation, and comfort. The precautionary measures indicated in paragraph 14-4 for freight cars and cabooses are generally applicable to passenger-type equipment, except that in most cases additional care is required All glass surfaces (windows, doors, etc.), screwheads, bearing and lubrication oilholes, rubber components, hinge pins, signal valves, pressure gages, wheels, axles, journal box parts, and all other surfaces or openings where paint may be detrimental to operation or use, will be masked or otherwise suitably protected during painting. Safety markings will not be applied on railway equipment to be used outside the United States. All priming and finish coats will be applied so that the work, when finished, will present a smooth, uniform coating with good adhesion over the entire surface. The various paints authorized for use in painting passenger-type railway equipment are listed in table 14-3. Passenger and Army Medical Department cars will be painted and stenciled as provided in AR 746-1.

Table 14-3. Painting of Ambulance Cars

Area	Extent	Coats	Paint
Interior	*a.* Head lining,[1] overhead water tanks	2	Ivory enamel
	b. Vertical surfaces on sides of car from head lining down to windowsill,[1] toilets; service sink-room, partitions.	2	Light blue enamel
	c. Vertical surfaces on sides of car from windowsill to floor;[1] heater-pipe guards; lockers; doors.	2	Deep blue enamel
	d. End walls from ceiling to floor[1]	2	Deep blue enamel, 14064
Exterior	All exposed exterior surfaces including roof, sides,[1] ends,[1] underframe, trucks and components,[2] battery boxes, pressure water tanks, etc.	2	Olive green or stratablue[3] enamel.
Battery box and switch board locker.	Interior surfaces and blocking	2	Acid-resistant varnish

[1] After the priming coat, the following operations will be performed before application of the finish coat; apply one coat of synthetic surfacer; fill in imperfections with putty and glazing compound, wet- or dry-sand the entire surface, apply a second coat of synthetic surfacer.
[2] Paint applied to trucks and components will be thinned out sufficiently so that detection of cracks or other flaws is facilitated. Wheels, axles, and parts contained in journal boxes will not be painted.
[3] Applicable to Air Force equipment only.

14-7. Application of Materials

Protective coatings will be applied in thin, even coats. Particular care will be used to insure complete coverage of corners or other surfaces difficult of access. All bare and abraded spots in each coat will be touched up. Each coat will be completely dry before the succeeding coat is applied. Each coat will be free from sags, blisters, brush marks, evidence of poor adhesion, or other deficiencies. Surfaces will be dusted, and a tack rag will be used to free them from dust before application of paint. The primer coat will be sanded lightly. Tables 14-3, 14-4, and 14-5 show the type and number of primer and finish coats to be applied to the various portions of passenger, troop kitchen, and ambulance cars.

Table 14-4. Painting of Kitchen Cars

Area	Extent	Coats	Paint
Interior	*a.* Walls, lockers, tables,[1] shelves, water tanks, etc.	2	Buff enamel
	b. Ceiling	2	Cream enamel
	c. Floor and floor racks	2	Red deck 14064
Exterior	All exposed surfaces, including roof, doors, sides,[2] underframe, truck and components[3]	2	Olive green or strata-blue[4] enamel.
Battery box and switch board locker.	Interior surfaces and blocking	2	Acid-resistant varnish

[1] Wooden table, sink, and other worktops will not be painted.
[2] Smoothing cement will be applied to rough spots and sanded smooth before application of primer.
[3] Paint applied to truck and components will be thinned out sufficiently so that detection of cracks or other flaws is facilitated. Wheels, axles, and parts contained in the journal box will not be painted.
[4] Applicable to Air Force equipment only.

Table 14-5. Painting of Troop Sleeper Cars

Area	Extent	Coats	Paint
Interior	*a.* Head lining[1]	2	Eggshell enamel
	b. Vertical surfaces on sides of car from head lining down to windowsill[1]	2	Cream enamel
	c. Vertical surfaces on sides of car from windowsill down to floor;[1] lockers; doors; partitions; heater pipe guards.	2	Light brown enamel
Exterior	All exposed surfaces, including roof, sides,[1] ends, underframe, trucks and components,[2] battery boxes.	2	Olive green 14064 or strata-blue[3] enamel.
Battery box and switch board locker.	Interior surfaces and blocking	2	Acid-resistant varnish

[1] After the priming coat, the following operations will be performed before application of the finish coat Apply one coat of synthetic surfacer, fill in imperfections with putty and glazing compound, wet- or dry-sand the entire surface, apply a second coat of synthetic surfacer.
[2] Paint applied to trucks and components will be thinned out sufficiently so that detection of cracks or other flaws is facilitated. Wheels, axles, and parts contained in the journal box will not be painted.
[3] Applicable to Air Force equipment only.

CHAPTER 15

LETTERING AND NUMBERING OF RAILWAY FREIGHT AND PASSENGER CARS

Section I. GENERAL

15-1. Purpose

The primary purpose of lettering and numbering is to identify and classify equipment. Marking will be in clear-cut, properly located figures and will reflect the same high quality of workmanship as that in the equipment itself. Distinction can be lent to an engineering design with letters and numbers of neatness, strength, and quality that contribute to the general appearance of the equipment Even the roughest freight equipment will be given the highest possible degree of perfection in balance, proportion, and design of its markings. It is extremely important that letters and numbers be legible and correctly placed, since they often must be copied from the equipment by yard or train personnel at night, and while the equipment is in motion.

15-2. Requirements

a. Lettering and numbering of Department of the Army (DA) railroad equipment will comply with requirements of AR 55-255, AR 55-650, AR 746-1, Military Specification 3320, and MIL STD 129. Letters and numbers illustrated in figure 15-1 are authorized for all Army-owned railroad equipment and will insure uniformity in identification and classification labels. Proportion has been analyzed mathematically and geometrically in the drawings

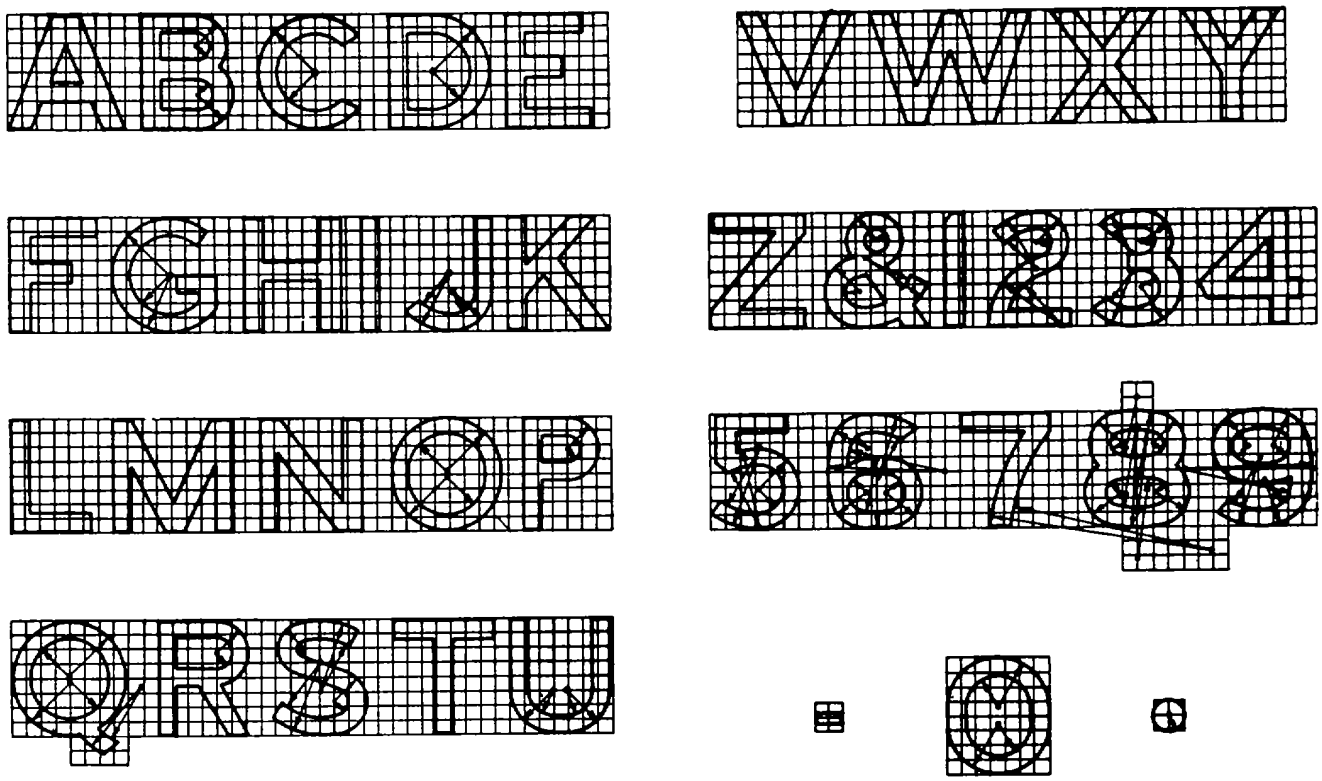


Figure 15-1. Typical letters and numbers.

b. Illustrations in this manual are presented as typical of the various types of cars used by the Department of the Army. Marking arrangements must be flexible to fit all types. On some cars, it will be impossible to adhere strictly to size, arrangement, and location of markings as illustrated. Information in figures 15-2 to 15-6, as appropriate, will be shown in its entirety on the cars in all cases. Information not shown on the drawings will not be added unless specifically authorized by the US Army Mobility Equipment Command. Markings on freight and passenger cars will be arranged so as to present the same view from either side,

c. US Army and US Air Force-owned freight and passenger equipment meeting AAR and DOT specifications and required to operate on railroad systems in the United States, Canada, and Mexico, will have the reporting marks USAX or DAFX. US Navy-owned cars are marked USNX. All other equipment will have the reporting marks USA, USN, or DAF. Department of Defense-owned cars of the interchange fleet are marked DODX. Military service-owned rail equipment not marked with the letter "X" following ownership designation is restricted to interinstallation use.

Section II. FREIGHT CARS

15-3. Boxcars, Flatcars, Gondola, Hopper, and Caboose (Guard) Cars in CONUS

a. White gloss enamel No. 17875 will be used for letters and numbers. All exposed exterior painted surfaces on boxcars, flatcars, and caboose (guard) cars will be painted gloss olive green No. 14064. All exposed exterior painted surfaces on gondola, hopper, and Army-owned tank cars will be painted gloss black No. 17038, as prescribed by AR 746-1 Markings and lettering, including those on trucks and underframes, will conform to the applicable provisions of the Manual of Standard and Recommended Practices, and to the AAR Code of Rules governing the condition of and repairs to freight and passenger cars. Army-owned cars which are acceptable to commercial railroads for interchange and which meet all requirements will be reported to the US Army Mobility Equipment Command. These cars, when authorized, bear USAX and the car number.

b. Seven to nine-inch characters will be used and will be located to suit car construction (fig 1'5-2 to 15-6) Reporting marks on ends of the car, on trucks, and on purlins or the wall inside the car, will be 4-inch characters (fig 15-2 to 156). Letters and numbers will be uniformly spaced. Weights will be shown as follows:

(1) The capacity (CAP) of the car will be shown in pounds to the nearest 1,000 pounds. This capacity is the normal loading assigned to the car and is based on the size of its axles.

(2) The load limit (LD LMT) is the actual limitation on loading based on the difference between the total weight on the rails permitted by the size of the axle used and the lightweight of the car. When cars cannot carry this maximum load, the actual loading permissible will be shown and a star will precede the load-limit marking. (3) The lightweight (LT WT) is the actual scale lightweight of the car in multiples of 100 pounds.

c. The full data carried on boxcars follows in d through *i* below. On all other types of cars, only such dimensions as actually exist will be covered by these markings. Dimensions indicating eaves width and height (EW & H) are defined as follows:

(1) Eaves width is the outside width of a car at the top of the eaves (upper eaves if car is equipped with Z-bar side plate), except on cars having a latitudinal running board extension, in which case, eaves measure from the outside edge of the top of the latitudinal running board to a corresponding point on the opposite side of the car.

(2) Eaves height is the height from the top of the rails to the eaves (upper eaves if car is equipped with Z-bar side plate), except on cars having latitudinal running board extension, where it is the height to the top of the latitudinal running board extension at the side of the car.

d. For all cars standing more than 12 feet from the top of the rail to the eaves, an additional set of dimensions will be shown on the car. These will indicate the car's extreme width and height (EXW & H).

(1) Extreme width is the measurement taken from the attachment projecting to the greatest extent around eaves.

(2) Extreme height at extreme width is the distance from the top of the rail to the point where extreme width exists. e. Inside width, inside length, and inside height are represented as IW, IL, and IH respectively. For all dimensions, fractions are omitted. For inside dimensions they are dropped,

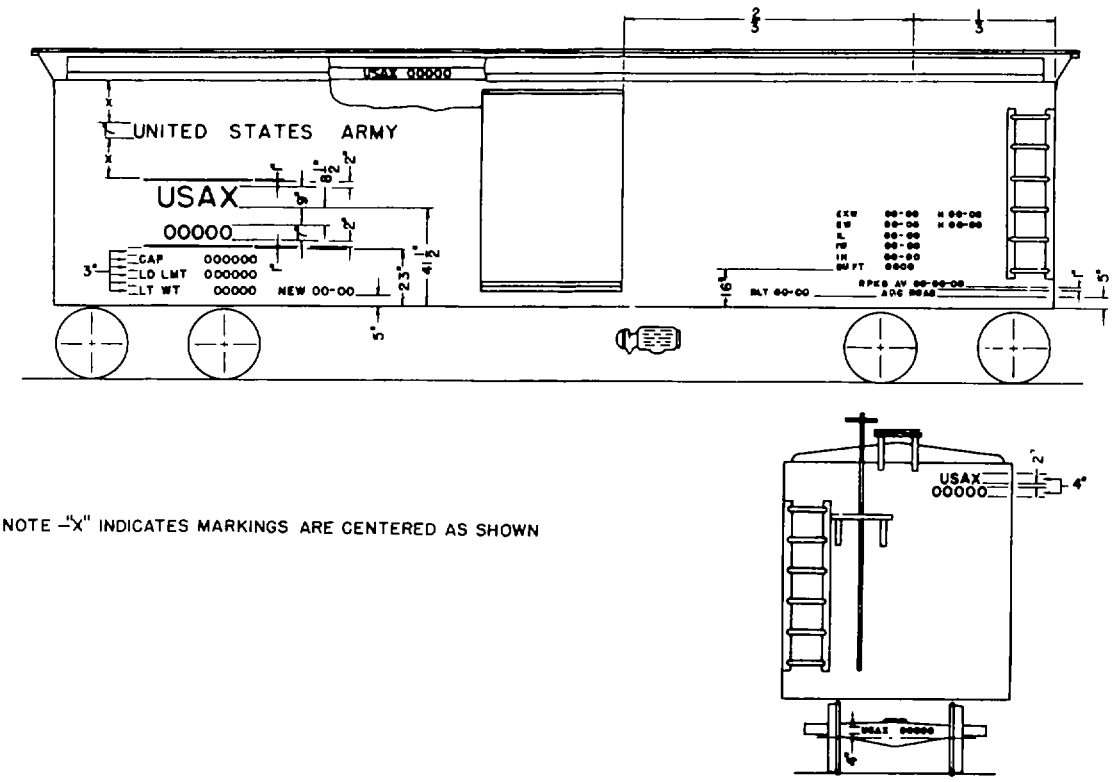


Figure 15-2. Standard markings for boxcars and refrigerator cars, CONUS.

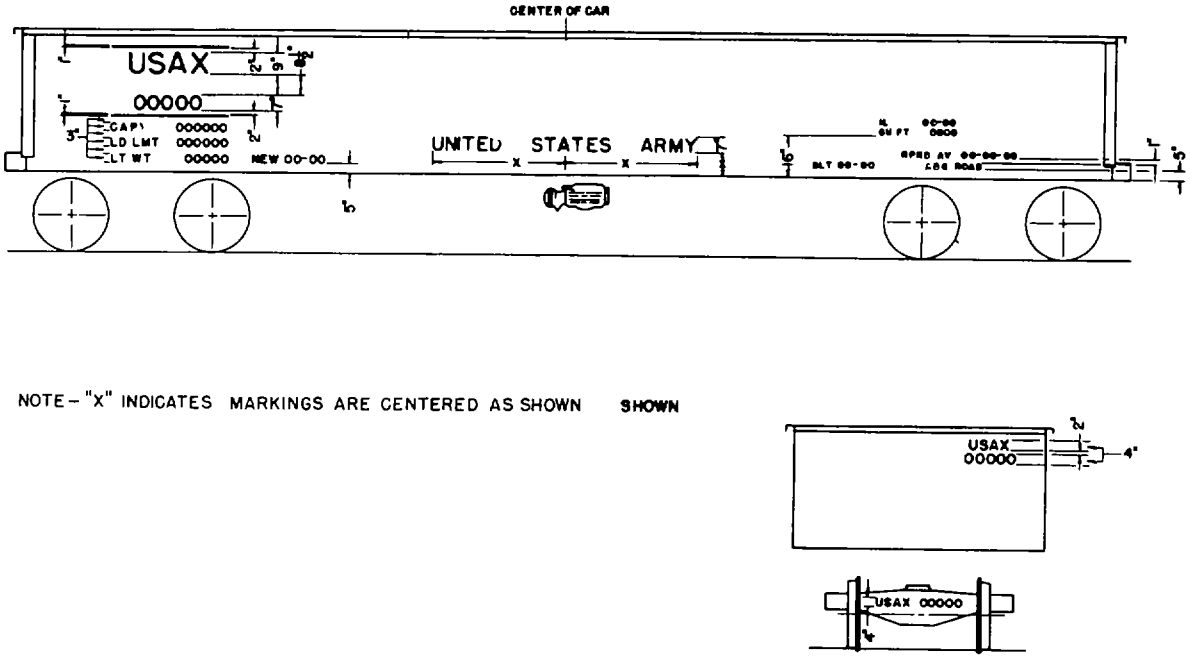


Figure 15-3. Standard markings for gondola cars, CONUS.

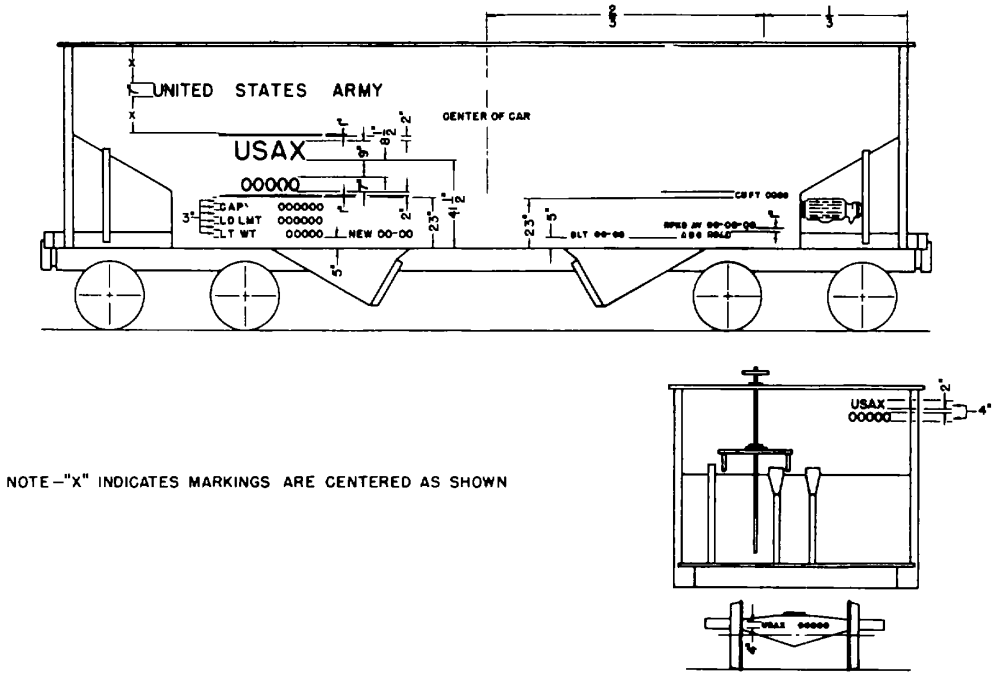


Figure 15-4. Standard markings for hopper cars, CONUS.

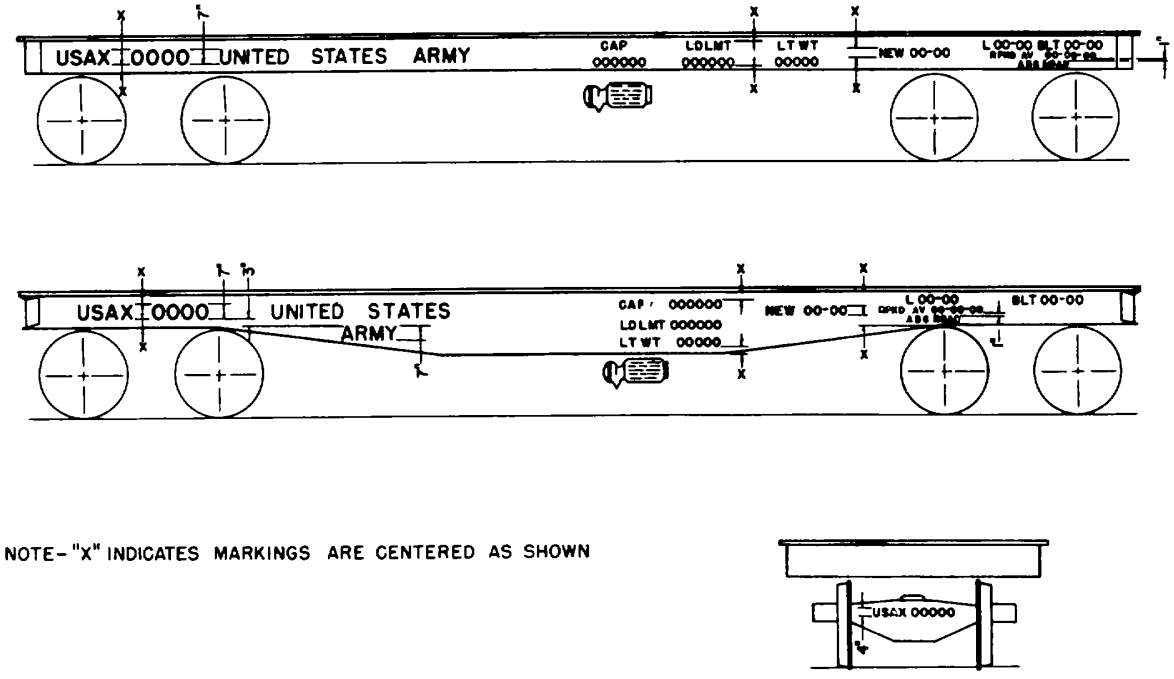
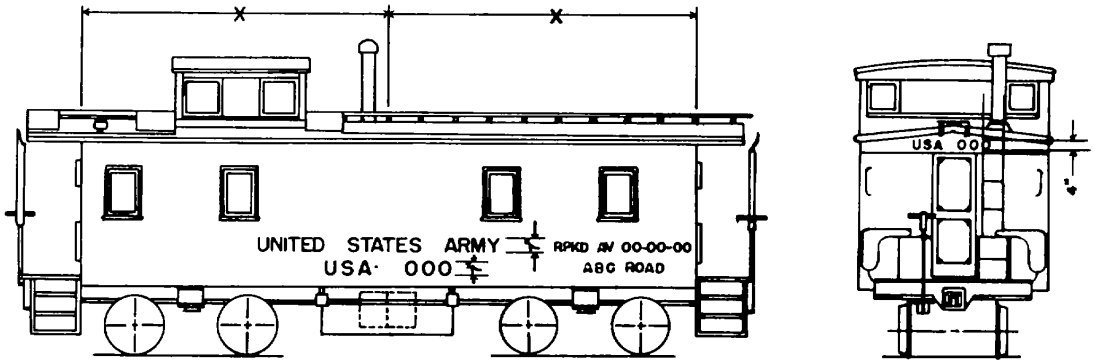


Figure 15-5. Standard markings for flatcars, CONUS.



NOTE—"X" INDICATES MARKINGS ARE CENTERED AS SHOWN

Figure 15-6. Standard markings for caboose cars, CONUS.

and for outside dimensions, the next full inch is used. Cubic capacity (CU FT) is the inside cubage; inside dimensions are used for computation. All above markings *(d* and *e)* will be in 2-inch characters and spacing

f. On newly built cars, the NEW date with 3 inch letters and numbers will be shown. When the car has been rebuilt, the letters RBLT will be used and the date indicated.

g. Airbrake cleaning data marking will include the place, month, day, and year of the last airbrake cleaning. The reporting marks will be shown on the auxiliary reservoir in 1 1/2-inch letters and numerals, with 1-inch spacing between lines. Stock will be one-fourth of an inch and bridges will be not more than three-sixteenths of an inch wide. If markings are not located to present a clear view from the outside of the car, stenciling will be near the handle of the release rod on the reservoir side of the car (fig 8-19).

(1) The stenciling for periodic airbrake cleaning, etc., is of such importance that special care must be taken to obtain in full detail the correct record of old markings before they are removed. If the old markings are indistinct due to grime, etc., they should be carefully cleaned so that the correct information can be ascertained, if possible.

(2) All old marks must be scraped off and painted over with quick-drying paint (preferably black), which should be dry before new marks are applied

(3) The new marks must be correctly located as designated and must not be duplicated. This stencil must conform to the standard block type design (fig 1'5-1). The stencil must be kept clean, and the marks should be applied in a neat and exact manner. After the new marks have been applied, they should be carefully inspected to insure their correctness in all details.

h. Journal box repacking data for cars used in interchange must be in accordance with the code of rules and conform to instructions contained in paragraph 4-14c. For cars not used in interchange, the date and location of the last periodic jacking and repacking will be shown; for example, RPKD-FE-1-6-72 USAX.

i. On equipment owned and operated by DA, the words UNITED STATES ARMY in 7-inch letters, will be placed on both sides of cars in the location indicated by figures 15-2 through 15-6.

15-4. Army Tank Cars in CONUS

a. White gloss enamel No. 17875 will be used for all letters, numbers, and insignia. Markings on tank cars are in more detail than markings on other freight cars because tank cars, for safety reasons, have been divided into several classes by Department of Transportation (DOT) regulations. Each class is marked according to the type of commodity it is designed to handle. These classifications will be followed in lettering and numbering tank cars which will be used in interchange on commercial railroads.

b. Regulations referred to in a above will be used in conjunction with instructions in this manual to govern the lettering and numbering of Army-owned new tank cars, new tank-car structures, new tanks for existing car structures, and tank cars that have been repainted.

c. Tank cars that are acceptable for interchange with commercial railroads will bear the reporting marks USAX (AR 746-1).

d. When tank cars are repainted and restenciled, restenciling will be as illustrated in figure 15-7.

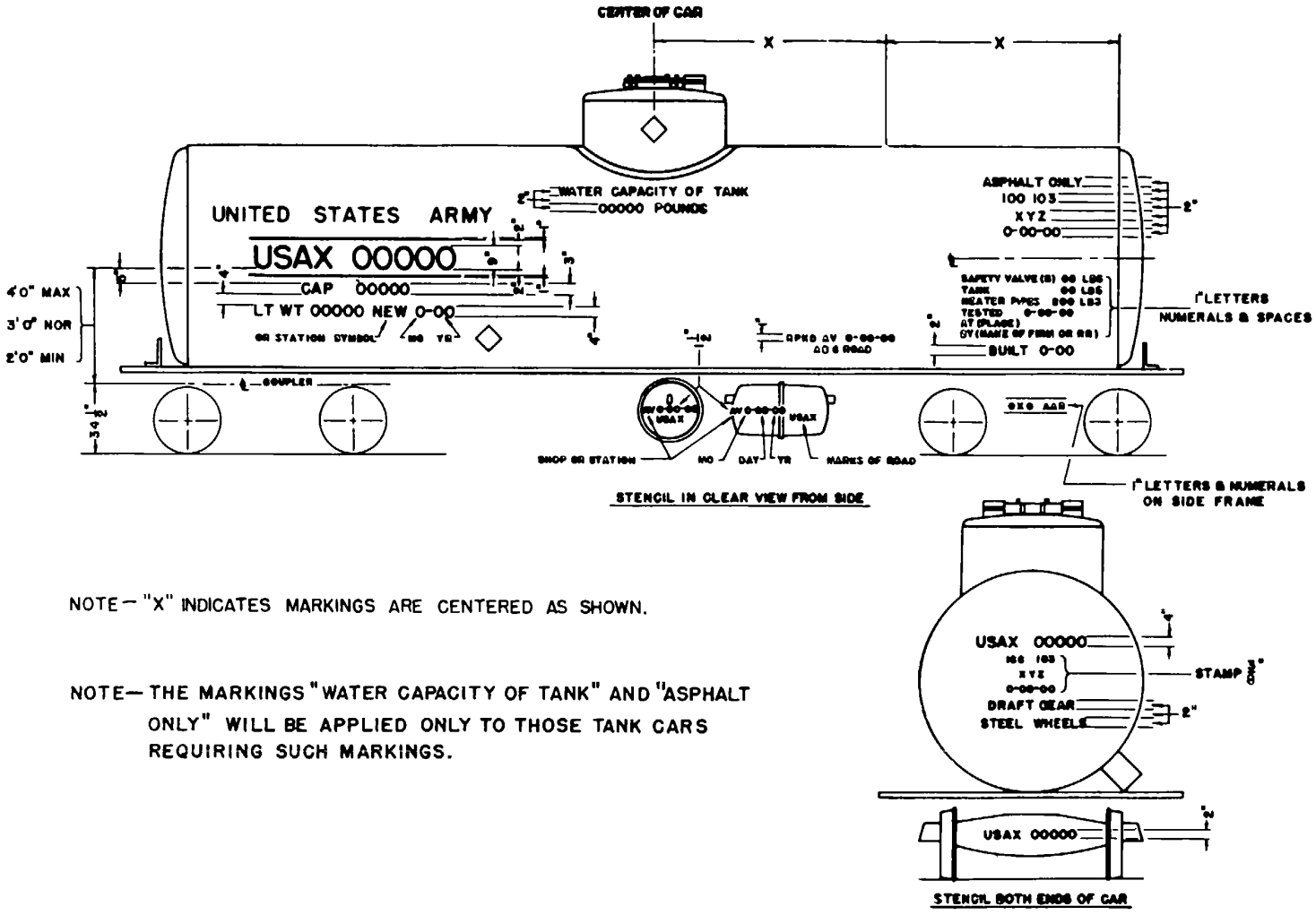


Figure 15-7. Standard markings for tank cars, CONUS.

(1) Location, size, and spacing of letters and numerals will be as indicated.

(2) Tank car reporting marks will be placed between the horizontal bars and located as shown.

(3) Reporting marks, capacity, lightweight, and date will be as shown, except that the entire arrangement may be moved slightly to suit construction of the car.

(4) The number of the DOT or AAR specifications (preceded by the initials DOT or AAR) applicable to the tank will be stenciled on both sides of the tank, or jacket if lagged, in letters and figures at least 2 inches high. The initials of the manufacturer and the date of the original test of the tank will also be stenciled in letters and figures at least 2 inches high on the sides of the tank, or Jacket if lagged, immediately below the specification number. In addition, the letters DOT or AAR and the specification number applicable to the tank, the initials of the manufacturer, and the date of the original test, in letters and numerals at least three-eights of an inch high, will be stamped plainly and permanently into the metal near the center of both outside heads of the tank.

(5) For cars requiring water capacity markings, the water capacity of the tank in pounds will be stamped plainly and permanently in letters and figures at least 3/8 of an inch high into the metal of both outside tank heads, immediately below the marking specified in (4), above This marking, in letters and numerals at least 2 inches high, will also be stenciled as shown on each side of the jacket immediately below the dome platform and directly behind the ladders, if any.

(6) The car number and initials will be stenciled on underframe center sills or side sills and on both truck bolsters.

(7) When airbrakes are cleaned, oiled, tested, and stenciled in conformance with interchange rule 60, the initials of the road doing the work, the initials of the shop or station at which the work is done, and the date will be stenciled in the location shown (fig 1'5-7).

(8) Lined tanks, which are not required to be tested under DOT specifications, and wooden tanks will be stenciled to indicate that tests are not required For example, RUBBER-LINES TANK-PRESSURE TEST NOT REQUIRED; COATED TANK-PRESSURE TEST NOT REQUIRED; or TREATED TANK-PRESSURE TEST NOT REQUIRED.

(9) When tank cars bearing a DOT specification number are designed and authorized for the transportation of a particular commodity only, the name of that commodity followed by the word ONLY or such other wording as may be required to indicate the limits of usage of the car will be stenciled on each side of the tank, or jacket if lagged, in 2-inch letters. AAR specification tank cars of classes 201A35, 203, 201A35-W, and 203-W will be stenciled on each side in 2-inch letters to indicate the name of the commodity for which the tank and its appurtenances are designed and authorized. This will be followed by the word ONLY or such other wording as may be required to indicate the limits of usage of the car.

(10) All DOT-103, DOT-103W, DOT104, and DOT-104W tank cars equipped with safety vents will be stenciled NOT FOR FLAMMABLE LIQUIDS in 2-inch letters on the side of the tank, or jacket if lagged. All DOT-104 and DOT-104W tank cars equipped with safety valves set to open at 35 pounds per square inch, as authorized in note 3 to section 110(c)(8) of the DOT tank car regulations, will be stenciled FOR VAPOR PRESSURES NOT EXCEEDING 40 POUNDS PER SQUARE INCH, ABSOLUTE, AT 1'00° F. in 2-inch letters.

(11) Cars whose journal boxes are periodically repacked in conformance with interchange rule 66 will be stenciled on the underframe or on the tank of cars without an underframe. The place (railroad and station), month, day, and year will be included in the stenciling.

(12) Cars marked to provide information concerning AB brakes, draft gears, couplers, brake beams, wheels, dirt collectors, tank capacity in gallons, etc., will be stenciled on heads of tanks, or jacket if lagged, using 2 or 3-inch letters and numerals with 2-inch spacing between words. Abbreviations will be used; for example, NO. 15 BR BM for No. 15 brake beam.

(13) Where tank, safety valve, and heater systems are tested on the same date, it is preferable to use a combination stenciling covering these tests, but if these systems are tested on different date, individual stenciling covering the tests may be applied.

(14) The size of journals and the letters AAR will be stenciled on trucks where lettering is not cast integral on the side frame.

(15) The date a car was built new, including day, month, and year will be stenciled in 2 or 3 inch characters as shown, or a badge plate will be applied giving this information. Where car

structures and tanks have been built on separate dates, see AAR interchange rule 3, section s.

(16) On all cars used for the transportation of commodities classified as dangerous by DOT regulations, metal placard holders will be applied to both sides of the car as near the center of the car as possible, and to both ends in the location shown.

(17) In no event will the capacity as stenciled on the card exceed the load limit based on the axle capacity.

(18) Tank cars of classes DOT--103, DOT-103W, DOT-104, and DOT-104W, with manhole closures equipped with approved safeguards which make removal of closures from manhole openings practically impossible while tank interior is subjected to vapor pressure of lading, will be stenciled on each side of dome, or jacket if lagged. Stenciling will be in line with ladders and in a color which contrasts with the color of the dome Manhole closure identification marks as shown will be included in the stencil. For dimensions, see paragraph 20(h) of DOT103 specifications. Tank cars of classes ARA-II, ARA-III, ARA-IV, DOT-103, DOT-103W, DOT-104, and DOT-104W, built before the effective date of these specifications, which now have manhole closures equipped with the approved safeguards mentioned above, will be stenciled as required by DOT regulations on each side of the dome, or jacket if lagged, in line with the ladders. A color which contrasts with the color of the dome will be used (DOT regulations).

(19) Brake lever diagram metal badge plates will be attached (AAR interchange rule 3, section (b)).

e. On tank cars owned and operated by the Department of the Army, the words UNITED STATES ARMY in 7-inch letters, will be located 7 inches above the top horizontal bar and centered above the reporting marks and car number (typical letters are shown In figure 15-1).

15-5. Boxcars, Flatcars, Gondolas, Caboose, and Refrigerator Cars in Theaters of Operations

a. White gloss enamel No. 17875 will be used for all insignia, letters, and numbers. Letters and numbers will conform to figure 15-1. Boxcar and refrigerator car markings are shown in figure 158, and gondola car markings are shown in figures 15-9 and 15-10. Markings on flatcars will conform to figures 15-10 and 15-11 and will be restricted to the information shown. Category numbers for European railcars (used by STANAG countries) are illustrated in figure 1512. Caboose markings are shown in figure 15-13.

b. The reporting marks USA and the car numbers on the sides of the car will be 7-inch characters. Reporting marks on the ends of cars will be 4-inch characters.

c. The capacity (CAP) and lightweight (LT WT) will be 2-inch characters. Load limit (LD LMT) will not be shown.

d. Inside width (IW), inside length (IL), and inside height (IH), as applicable, will be shown in 2-inch characters. For all dimensions, fractions will be dropped.

e. Airbrake cleaning data marking will be shown in 1-inch characters. Only the month, day, and year of the last airbrake cleaning will be shown.

f. Journal box repacking data (date only) will be shown in 1-inch characters (fig 15-2 to 15-6).

g. Foreign service flatcars destined for NATO countries shall be marked with category numbers in accordance with table L5-1. The category number (fig 15-12) shall be displayed on both sides of the car and located as shown in note 2, figure 15-11.

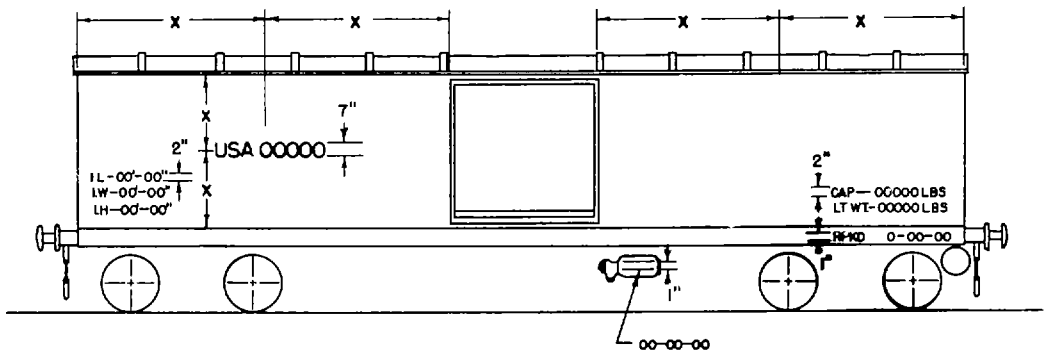
Table 15-1. STANAG 2153 Category Numbers

Capacity (tons)	Width of car	Category number
40	8' 7 1/4"	None
50	8' 7 1/4"	None
70		
Depressed center	9' 8"	5
80	9' 8"	5

15-6. Tank Cars, Theaters of Operations

a. White gloss enamel No. 17875 will be used for all letters, numbers, and insignia. Letters and numbers will conform to figure 15-1. Markings will conform to figure 15-14 and will be restricted to information shown so far as practicable. Deviation will be at the discretion of the headquarters of the military service of the theater concerned.

b. Reporting marks USA and the car number on the sides of the car will be 7-inch characters. !Reporting marks on the ends of the car will be 4-lunch characters.



NOTE — "X" INDICATES MARKINGS ARE CENTERED AS SHOWN

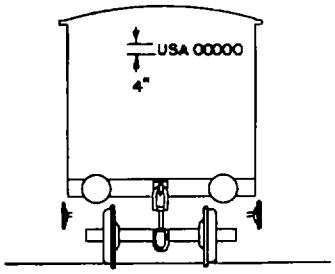


Figure 15-8. Standard markings for boxcars and refrigerator cars, theaters of operations.

c. The capacity (CAP) in pounds to the nearest 1,000 pounds will be shown in 2-inch characters on the sides of the tank.

d. The lightweight (LT WT) in pounds to the nearest 100 pounds will be shown In 2-inch characters on the sides of the tank.

e. The capacity of the tank in gallons will be shown in 2-inch characters on the ends of the tank.

f. Airbrake cleaning data (date only) will be shown in 1-inch characters (fig 15-14).

g Journal box repacking data (date only) will be shown in 1-inch characters.

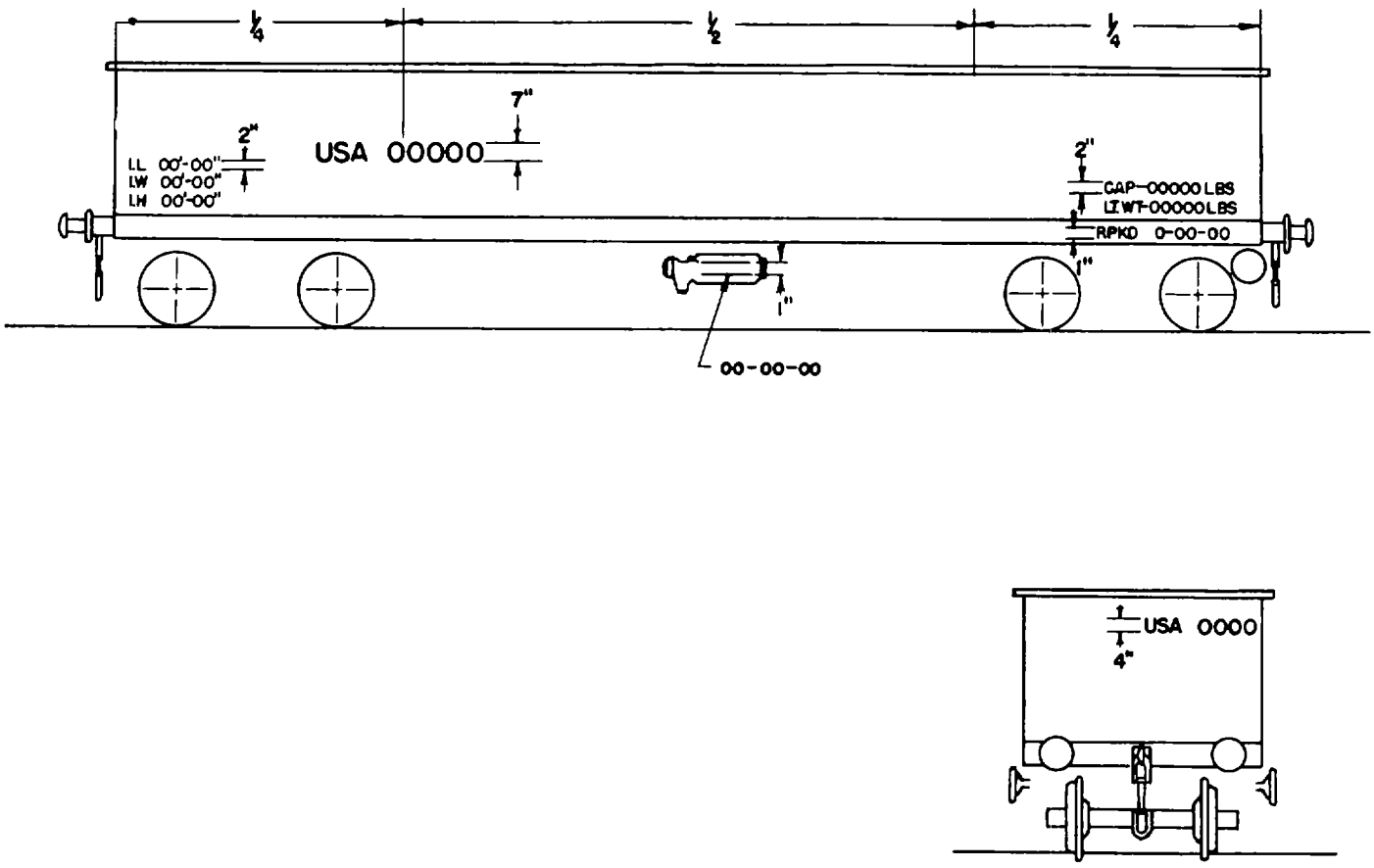
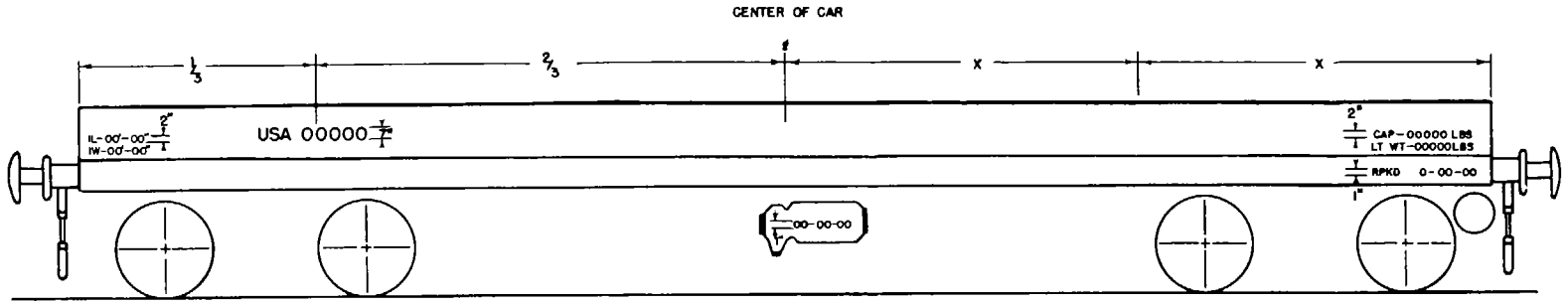


Figure 15-9. Standard markings for high-side gondola cars, theaters of operations.



NOTE — "X" INDICATES MARKINGS ARE CENTERED AS SHOWN.

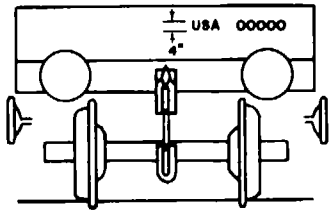


Figure 15-10. Standard markings for low-side gondola cars, theaters of operations.

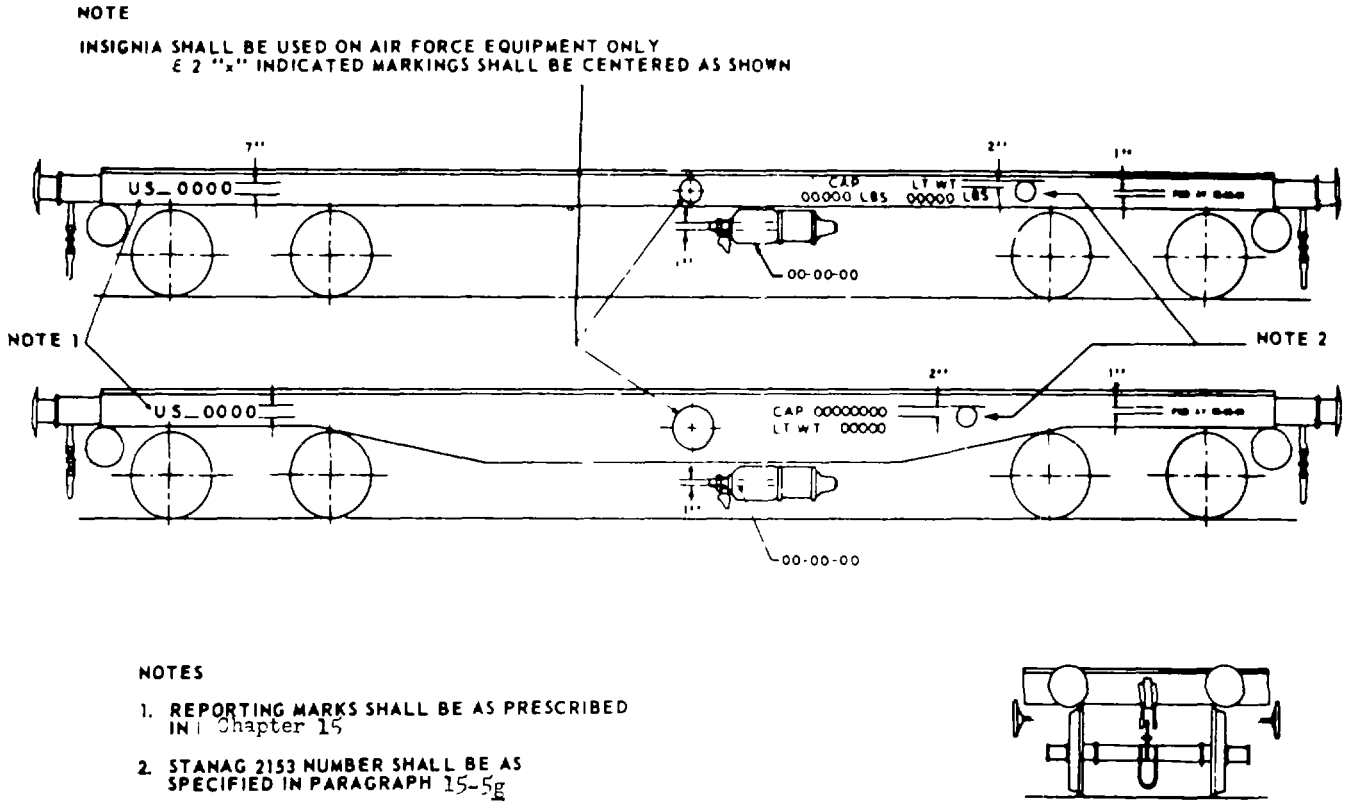


Figure 15-11. Standard markings for flatcars, theaters of operations.

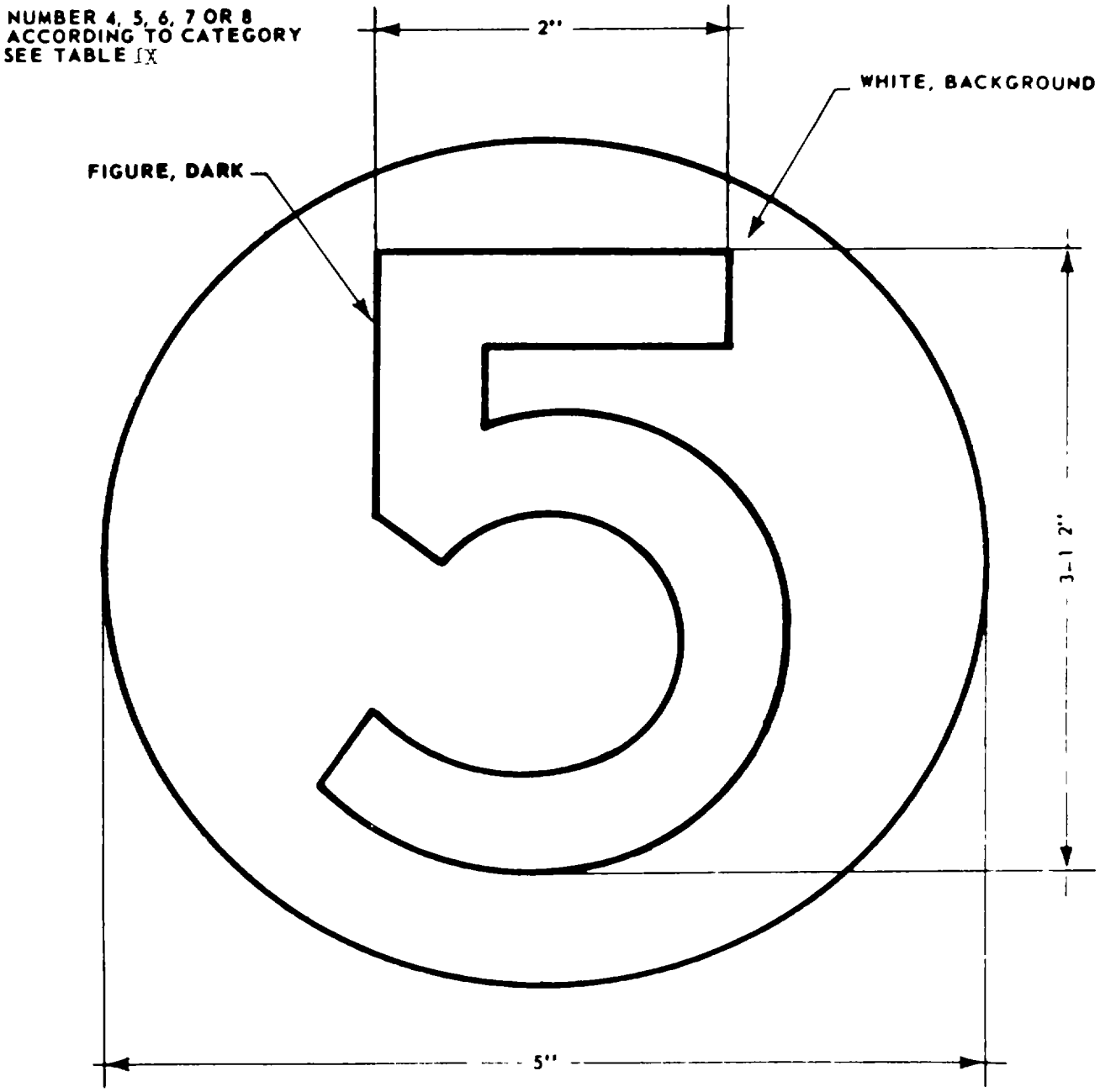
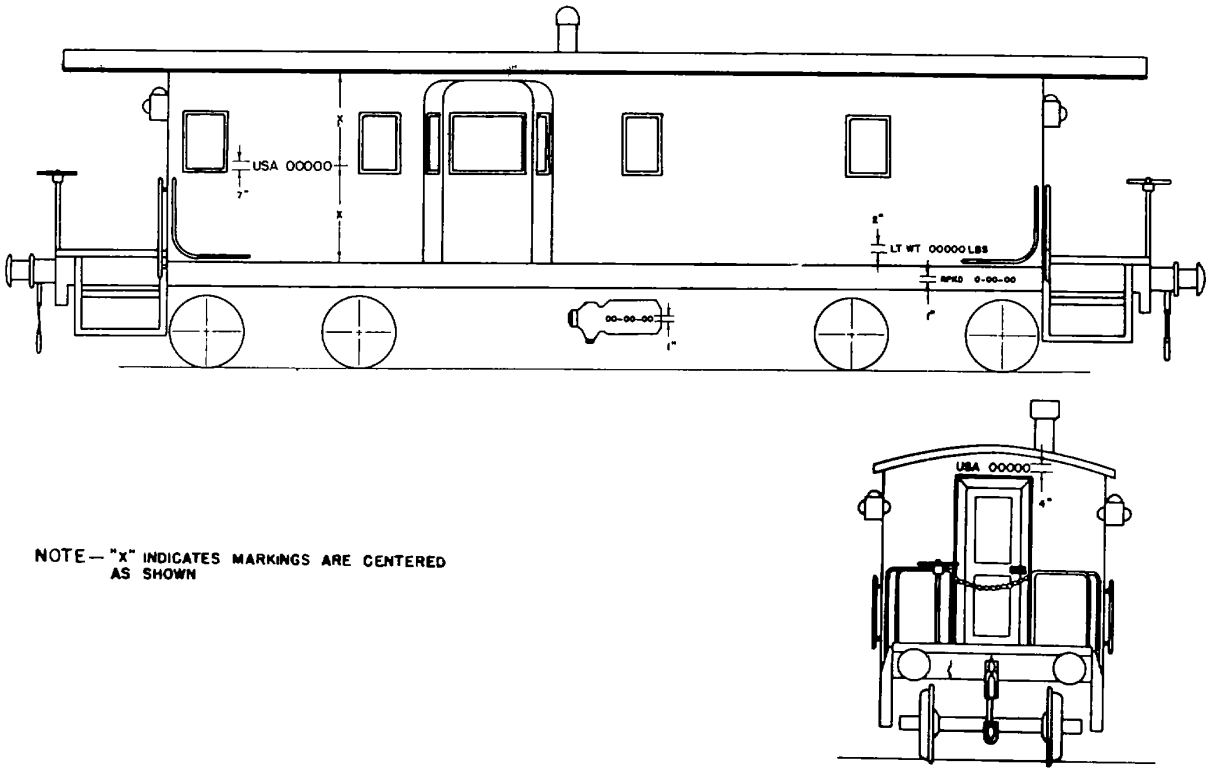
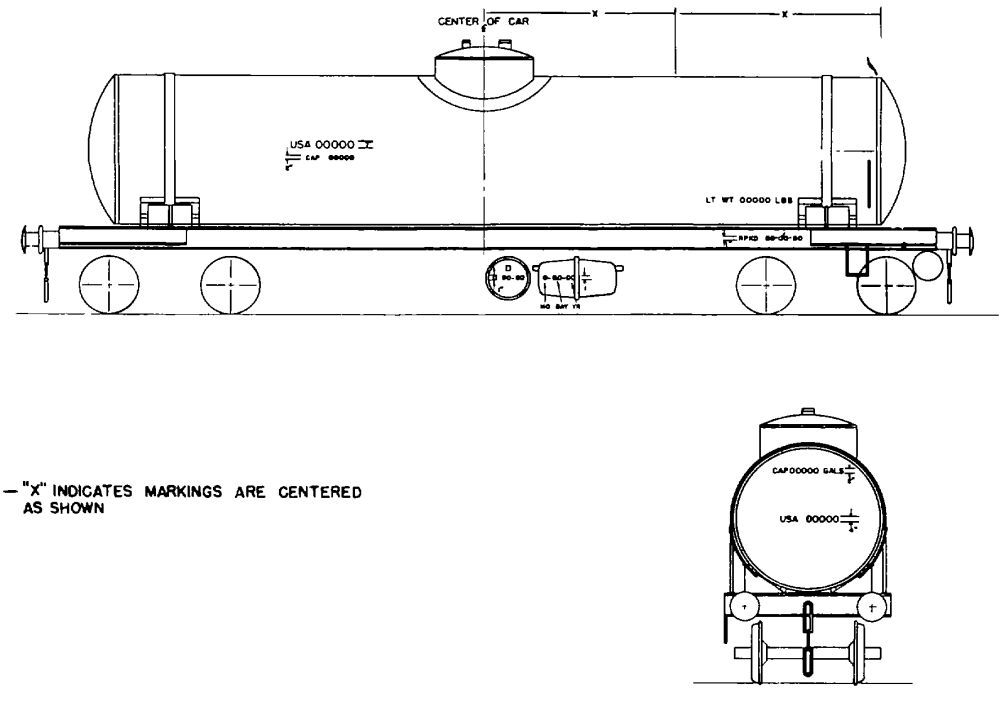


Figure 15-12. Category number for overseas (STANAG) railway cars.



NOTE — "X" INDICATES MARKINGS ARE CENTERED AS SHOWN

Figure 15-13. Standard markings for caboose cars, theaters of operations.



NOTE — "X" INDICATES MARKINGS ARE CENTERED AS SHOWN

Figure 15-14. Standard markings for tank care, theaters of operations.

Section III. PASSENGER 'SERVICE CARS

15-7. Passenger Cars in CONUS

a. It is not practicable to present standard procedures for lettering and numbering passenger equipment, since there is little use by the Department of the Army. However, the example illustrated in figure 15-15 should be used as a guide in marking passenger equipment.

b. All letters, numbers and insignia will be applied with white gloss enamel No. 17875, in accordance with AR 746-5.

c. On equipment owned and operated by DA, the words UNITED STATES ARMY will be applied in extended letters on the letter board on the side of the car in 7 or 9-inch letters to suit

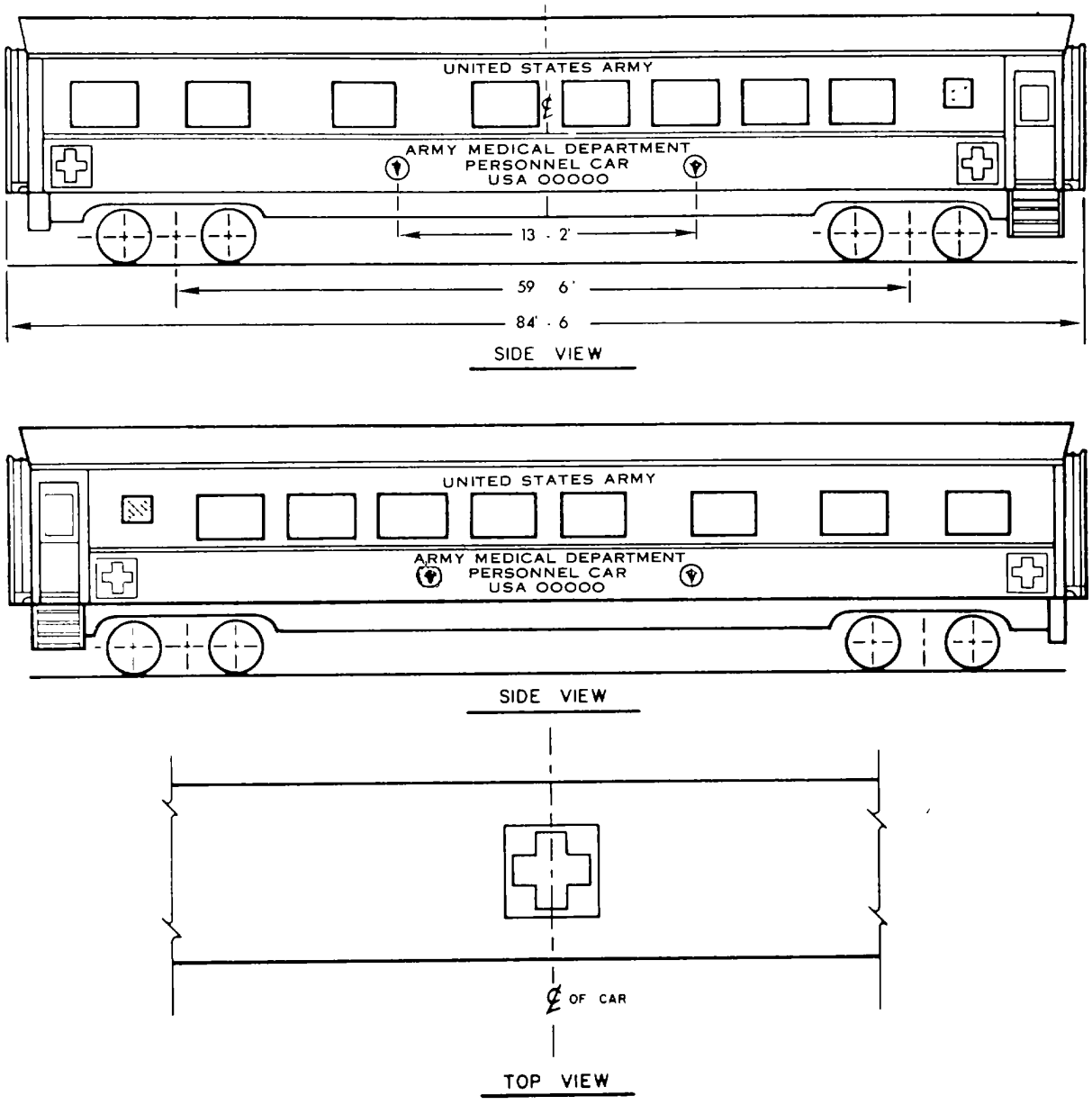


Figure 15-15. Standard markings for ambulance train cars.

the width of the board, approximately in the position shown in figure 1'5-15.

d. The car number, in 7-inch figures, will be located below the belt rail, centered on the side panel above each truck, and in 4-inch figures on the outside of the vestibule door at each end of the car.

e. Airbrake cleaning date will conform to the provisions of interchange rule 60 for all cars used in interchange. The place, month, day, and year of the last airbrake cleaning and the reporting marks will be shown on the auxiliary reservoir in 1 1/2-inch characters with 1-inch space between lines. If the marks are not located so as to present a clear view from the outside of the car, the stenciling will be placed near the handle of the release rod on the reservoir side of the car.

f. Journal box repacking data for cars used in interchange must be in accordance with AAR passenger car interchange rule 7 *(1)* (1). For cars not used in interchange, the date and location of the last periodic repacking is sufficient.

g. Size and positioning of markings for troop kitchen cars will be as indicated in figure 15-16.

15-8. Passenger Cars and Troop Kitchen Cars, Theaters of Operations In theaters of operations, passenger cars and troop kitchen cars ordinarily will be marked as in the continental United States. Deviations from markings illustrated in figures 15-15 and 15-16 will be at the discretion of the headquarters, transportation railway service, of the theater concerned.

15-9. Ambulance Cars, CONUS and Theaters of Operations

a. General. When it becomes necessary to renew lettering and numbering of ambulance cars, these markings will be restored as illustrated in figures 15-17 and 15-18. No deviations will be made from these instructions except upon authority from the Army Medical Department through the US Army Mobility Equipment Command.

b. Letters, Numbers, and Insignia

(1) All letters and numbers will be applied with white gloss enamel and will be of the style shown in figure 15-1.

(2) The Red Cross insignia will be applied with red enamel on a white enamel field. The caduceus (fill 15-19) will be red enamel.

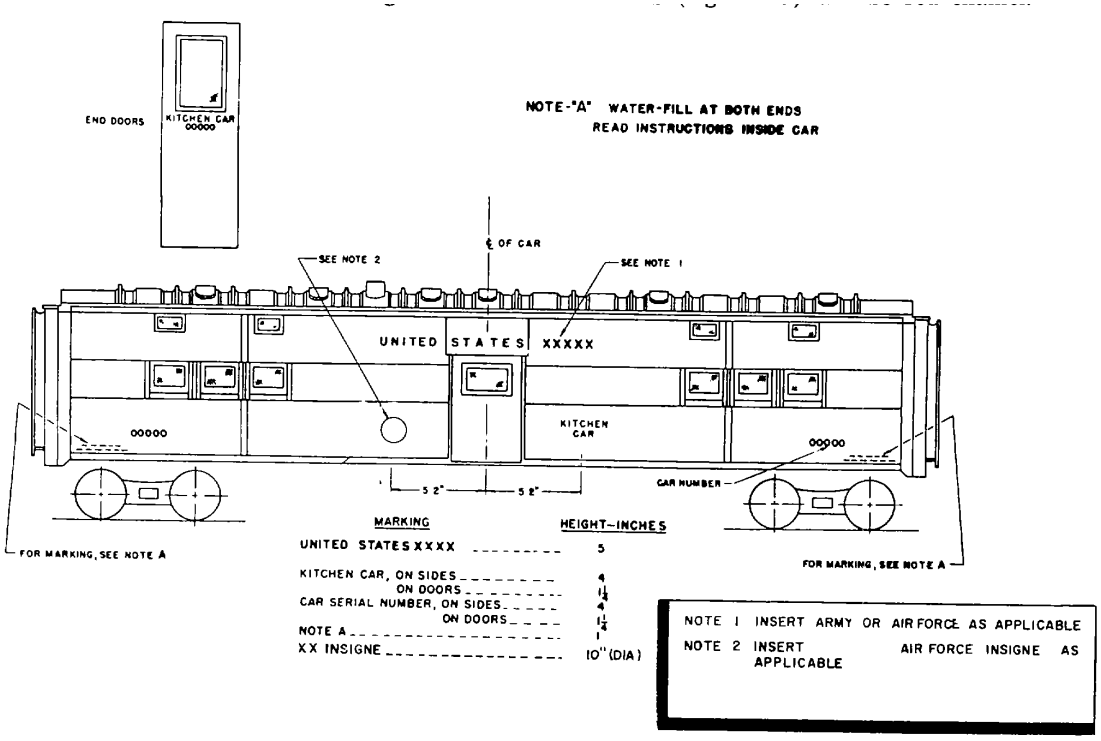


Figure 15-16. Standard markings for troop kitchen cars, CONUS and theaters of operations.

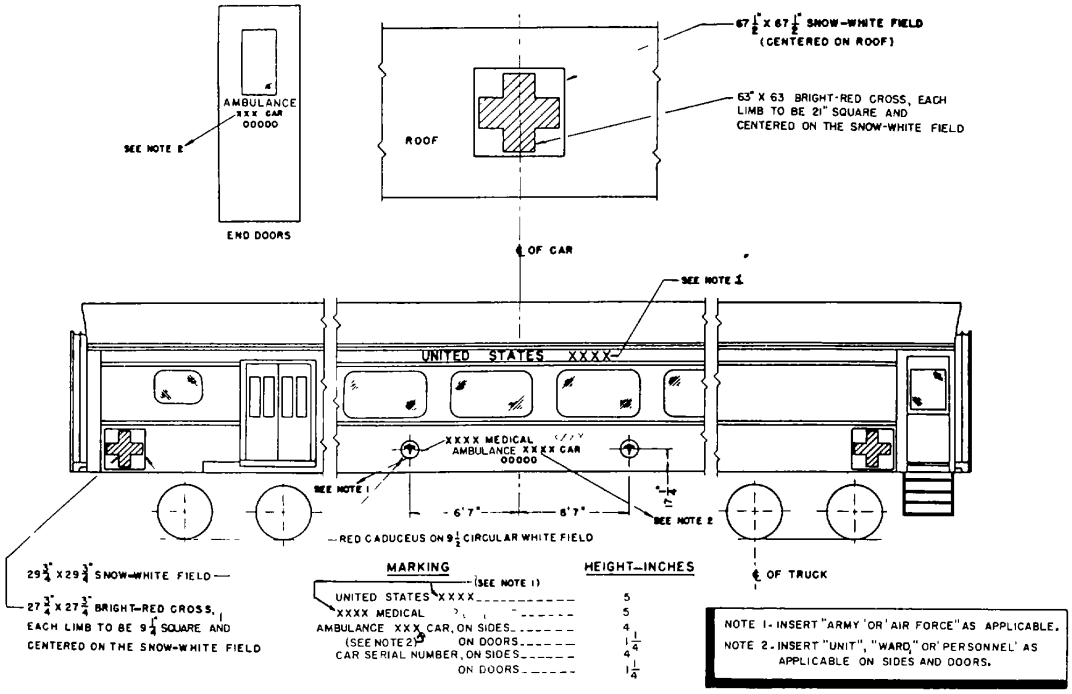


Figure 15-17. Standard Army Medical Department markings for ambulance unit cars, CONUS and theaters of operations.

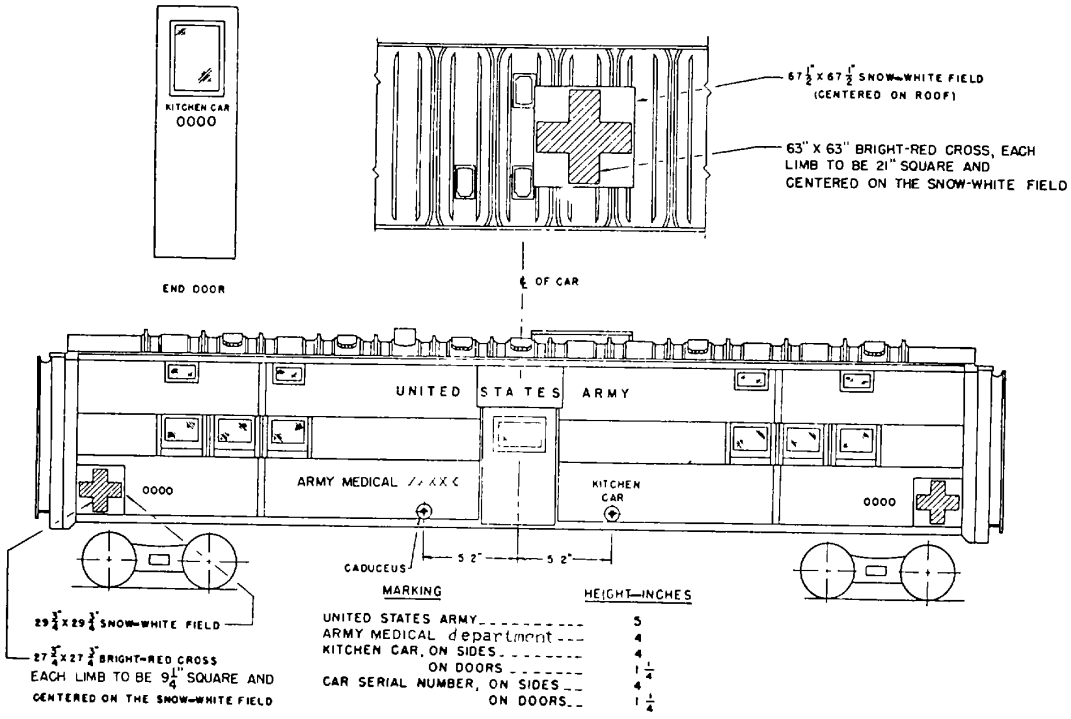


Figure 15-18. Standard Army Medical Department markings for ambulance kitchen cars, CONUS and theaters of operations.

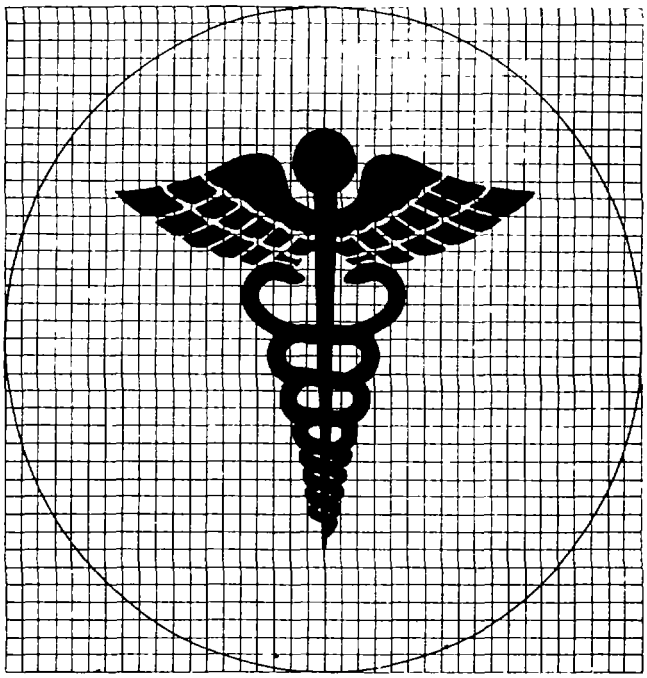


Figure 15-19. Caduceus, Army Medical Department insignia.

(3) The words UNITED STATES ARMY will be inscribed on letter boards of all cars.

(4) All numbers, letters, and insignia will be applied as shown in figures 15-17 and 15-18. Sizes and positions of markings will not be deviated from.

(5) Airbrake cleaning data will conform to provisions of interchange rule 60 for all cars used in interchange. The place, month, day, and year of the last airbrake cleaning and the reporting marks will be shown on the auxiliary reservoir in 1 1/2-inch characters with 1-inch space between lines. If marks are not located so as to present a clear view from the outside of the car, the stenciling will be near the handle of the release rod on the reservoir side of the car.

(6) Journal box repacking data (in accordance with passenger car interchange rule 7(1) (1) will be located on each side of each truck at corners diagonally opposite to each other where space permits; otherwise, It will be placed on the side of the car body at the platform end sill or the step side on corners diagonally opposite to each other. The day, the location, and the railroad marking of the last periodic packing and repacking will be shown; for example, RPKD FE-1-6-72 USAX.

PART FIVE

INSPECTION AND MAINTENANCE

CHAPTER 16

GENERAL

16-1. Inspections

There are two general categories of inspections which are performed on Army-owned rolling stock. One is the periodic and required inspection performed at Department of Army installations by the agencies having responsibility for the equipment as part of the maintenance program. The other type of inspection is that performed by railway inspectors. Anywhere that Army owned rolling stock is operated, in CONUS or in oversea areas, it will be subjected to such inspections Such cars will be inspected when received from an Army activity for movement, when delivered from one rail line to another at connecting line interchange points, and at the various yards and terminals through which they pass en route from origin to destination The details of inspections discussed herein are applicable to any type of inspection that DA civilian or military car inspectors may be required to perform.

16-2. Maintenance

a. General. Inspection reports showing the condition of worn or damaged parts requiring repair or replacement, the extent of maintenance required, and the record of work performed are responsibilities of the individual installation car inspector. He assures by visual examination that no defects exist which might affect the safe movement of a car and its contents. The overall responsibility for frequency of inspections and maintenance policies and procedures is vested in the Department of Defense agency which controls, operates, or utilizes the railway rolling stock concerned. Various forms used by Army Inspectors are discussed in chapter 17. Reports required will be prepared in compliance with applicable AMC directives. In oversea areas, such reports will be prepared as directed by the theater commander. TM 38-750, which contains general directives and facsimile forms required In the Army maintenance program, is not applicable to railway cars. Inspectors will check condition of Automatic Car Identification (ACI) labels where applied to DOD-owned cars in interchange service. ACI labels when originally applied will comply with AAR label application rules.

b. Cyclic Maintenance Inspection. Railway rolling stock in storage will be inspected at stated intervals in accordance with the type of storage on the following schedule:

(1) *Limited storage, 6 months or less.* Items placed in limited storage will be inspected every 90 days.

(2) *Standby storage, 6 to 12 months.* Items placed in standby storage will be inspected every 90 days.

(3) *Long-term storage, over 12 months.* These items will be inspected as follows:

(a) Items not stored under dehumidification, every 90 days.

(b) Items stored under dehumidification, annually. These items will have humidity readings taken each week and recorded.

c. Protective Maintenance Procedures. The procedures for maintenance and preservation of *stored* railway rolling stock, both freight and passenger equipment, are outlined in detail for the three categories of storage Just discussed in DA Technical Bulletin TC 14. In both limited and standby storage, car journals will be preserved by moving the equipment approximately 100 feet each month. Airbrakes will be preserved by operating or actuating the brakes four or five times during each monthly exercising. In long-term storage of cars not dehumidlfled, Journals will be preserved by removal of packing waste and lubricating oil, repacking with new waste, and saturation of journal boxes with prescribed pre-

servative oil (Type P-10, Grade 2). These cars will also be moved 100 feet or so monthly to distribute the preservative over the journals. Airbrakes also will be operated during this exercising as prescribed above.

16-3. Inspection Points

a. General. Railway cars are inspected at various places for different reasons. In normal railway practice, commercial or military-owned cars are inspected at terminals and classification yards when they arrive (in trains); when made up into trains for forwarding to the next yard; at interchange points when received from another railway; at loading points; and, at various repair or shop tracks On the railways of North America, Western Europe, or other areas where cars move freely between different rail lines and different countries, interchange inspection constitutes an important detail of through traffic movement. The techniques of car inspection and the various inspection objectives are discussed in the following paragraphs. The primary purpose of inspecting railway cars, like inspections of any item, is to determine the condition, suitability for service, extent of any needed repairs, etc Car inspectors should be technically qualified and should be equipped with inspector's hammer, reflector lamp (for night use), and packing hook. The specific general reasons for inspections at the various places listed in this paragraph are discussed below.

b. Receiving and Classification Yards. Cars are inspected on arrival for defects requiring immediate attention. Inspection includes draft and running gear and, if the car is loaded, inspection for leaking and for poorly secured or shifted lading. Cars requiring maintenance that cannot be completed on time for the movement of the train will be tagged "bad order" (para 17-10), cut out, and sent to a repair track for necessary servicing. After trains are made up, cars are again inspected to insure that they are in good condition before departure. This involves the inspection and testing of airbrakes, a thorough examination of journal boxes, and the detection of other possible defects developed during yard switching operations.

c. Loading Points. At loading points such as freight stations, industrial plants, military installations, etc., cars are inspected to insure the suitability of the car for the proposed lading; that all loading rules are (or were) properly observed; and that the lading is loaded, blocked, braced, or secured for safe movement.

d Interchange Points. Cars to be received from connecting lines are inspected to see that they conform to proper interchange loading and 'safety appliance rules (AAR and DOT in CONUS) and that they are in good mechanical condition. This Inspection precludes the receiving railway from accepting responsibility for defective equipment and/or damaged lading that occurred elsewhere.

e. Repair or Shop Tracks. The inspection of cars on repair or shop tracks involves a careful and thorough examination of all car details to determine the extent of repairs necessary. The kind and quantity of repair material required and the disposition of car for repairs largely depend on the results of these repair track inspections At railway shops and repair tracks, the class of repairs is determined by the number of man-hours required to make the repairs. Unlike the Army system, commercial railway repairs are designated light, medium, or heavy as follows:

(1) Light repairs: labor under 20 hours.

(2) Medium repairs: labor 2.0 hours to 50 hours.

(3) Heavy rep-airs: labor 50 hours or over.

16-4. Inspection Procedures-Freight Cars

a. General. In classification yards and terminals, two car inspectors (one on either side) should meet each incoming train for a general visual inspection of the cars as they roll into the yard. Military installation inspectors should make similar inspections as drafts of cars are brought onto the installation from the delivering railway interchange track. Wheels that are pounding (flat spots) or wobbly, or that have broken flanges, can be spotted as the cars move slowly past the inspectors. Leaking air lines, low or dragging brake rigging, brakeshoes riding wheels, etc, will be readily visible These defects are more difficult to detect when cars are standing still. The train, or draft of cars, should be stretched when it is stopped with airbrakes applied to enable inspectors to more readily detect excessive piston travel, weak draft gears, broken yokes and yoke rivets, worn knuckle locks, wornout draft sills, short brake pipes, defective hose and coupler defects, broken truck frames, etc. Careful inspection will be made of each car in the draft or train after they are stopped. Any defects found will be corrected before the car is moved in another train, or car is loaded (if

empty), etc., as applicable. Flame torches will not be used in inspecting cars. Only electric, gas, or kerosene lamps, with glass reflectors, are authorized. The procedures next discussed are applicable to all types of cars; items pertinent to specific types of cars are discussed separately. (These same procedures are applicable to the periodic maintenance inspections of military owned rolling stock made by Army maintenance personnel.)

b. General Inspections. Car inspector will check over all cars just received in the yard or installation as follows:

(1) Couplers. Inspect knuckle, knuckle pin, coupler body, and carrying iron for cracks, wear, or other defects. Height should be checked with coupler gage, or in relation to another coupler.

(2) *Draft gears.* Check for broken or missing cross keys, cotter keys, loose or broken rivets, broken draft spring.

(3) *Safety appliances.* Check condition of brake wheels, brake chains, grab irons, ladders, brake steps, etc.

(4) *Underframes.* Inspect for bent, broken, or loose body bolster center plates and broken or missing side bearings Check sills for cracks -or brakes. Tap nuts and rivets with hammer.

(5) *Car trucks.* Inspect for cracked or broken side frames, missing or broken bolster springs, broken brake lever brackets, damaged center castings or center pins; inspect brake rigging for worn brakeshoes (replace 1/2 inch or less thick) broken brake hangers, brake rods, missing brake lever pins, or cotter keys.

(6) *Car wheels.* Inspect wheels for slid flats; shelled spots; brake burns; cracked, broken, or worn flanges; broken rims; bent axles; wheels loose on axle, etc.

(7) *Journal boxes* Inspect journals by raising the box lid and, through visual inspection and by use of the packing hook, assure that journal bearings and wedges are in good condition and in place, that the packing is placed properly against the journal, and that there is sufficient oil.

(8) *Superstructure.* Inspect end and side ladders, corner and end posts, brake shaft, siding, striking castings, uncoupling levers, etc.

(9) *Tightness check.* Tap all nuts with inspector's hammer to check for tightness.

c. Closed Cars. Car doors of box and refrigerator cars will be inspected for the following:

(1) Assure doors open and close without jamming or difficulty, and that when closed, they are weathertight and capable of being secured against pilferage.

(2) Roofs and sides do not leak.

(3) Insides will be inspected to determine for which ladings the car is not suitable (e.g, flour or sugar should not be placed in a leaky boxcar).

(4) Doors, hatches, and other openings of refrigerator cars will be inspected to insure tightness to fit; floors, roofs, and walls will be checked for air or water leaks. Bunkers will be examined for leaks.

(5) Heating, ventilating, and refrigerating equipment and appliances will be inspected for malfunctions or defects.

d. Open-Top Cars. The complete inspection of these cars includes the additional items peculiar to the type of car. These items include stake pockets on flatcars, end gates, bottom and side doors (if provided) on gondolas; hopper mechanism, drop-bottom doors, etc., on hopper cars, and pneumatic equipment on dump cars.

e. Tank Cars. When inspected under load, all parts of the cistern will be examined for leaks and discharge valve checked to see that it is watertight. Leaky tank cars "will be repaired before further movement, or the load transferred to another car. Inspections will include dome covers, dome valves, and heater coils (if used).

16-5. Inspection Procedures--Passenger Cars

a. General The inspection of passenger equipment is similar in many respects to freight cars. The inspection of couplers, draft gear, underframes, trucks, and wheels generally are the same. Since passenger cars carry human cargo, inspections must be complete and thorough and include other items peculiar to passenger equipment such as steam lines, steam hose connections, signal lines, signal valves, generators, batteries, motors, refrigerating equipment, water pipes, and the various heat, light, water and air conditioning controls.

b. General Inspections. In addition to the inspections prescribed in paragraph 16-4 for freight cars, the following items found only on passenger equipment will be inspected when passenger trains arrive at terminals where inspectors are located or when passenger cars are assembled to make up a train.

(1) *Doors and windows.* Doors should be inspected for proper operation, to insure that door checks and latches function, etc. Doors and windows will be checked for broken glass.

(2) *Heating and lights.* Heat and light switches, lights, heat valves, blowers, fans, pumps, compressors, thermostats, etc , will be inspected for proper functioning.

(3) *Superstructure.* Superstructure inspection includes roofs, sides, corner and vestibule posts, steps, handholds, ladders, marker brackets, trainline, air signal and steam heat fittings, buffers, diaphragms, gates, etc.

(4) *Trucks.* Elliptic springs, equalizer springs, and other parts not found on freight car trucks will be inspected for wear, damage, and proper functioning.

(5) *Interiors.* Interiors should be inspected for condition of baggage racks, seats, washroom facilities, etc.

166. Terminal Tests

a. General. As a general policy, trains will not depart from dispatching points where car repairs and materials are available for repairs unless all airbrakes are in good order and working properly. Cars found with inoperative airbrakes that cannot be quickly repaired will be cut out, tagged (para 16-4), and sent to shop tracks. Rolling stock which is not equipped with airbrakes, but has efficient handbrakes, handholds, steps, etc., can be handled, provided not more than 1'5 percent of the rolling stock in any train will be handbraked. The remaining 85 percent must be power braked with operative airbrake equipment.

b. Preparation for Movement. Cars, derricks, steam cranes, and shovels and similar rolling stock which are not equipped with airbrakes, will be fitted with a temporary 1 1/4-inch brake pipe with a 1 1/4-inch angle cock and standard air hose on each end. At each angle fitting, a standard shipping tag will be placed indicating the date and place where the pipe was applied. Handbraked equipment, fitted as indicated, will not be placed next to the locomotive, but may be placed anywhere else in the train. When more than one car or piece of equipment is to be handled, they will be scattered throughout the train but always between cars with operating airbrakes The tender of a steam locomotive will be counted as one car table 16-1 lists the number of cars that may have inoperative airbrakes in trains of varying lengths.

Table 16-1. Maximum Number of Cars with Inoperative Airbrakes

Number of cars in train	Maximum number of ears with Inoperative airbrakes
6 or less	0
7 to 13	1
14 to 19	2
20 to 26	3
27 to 33	4
34 to 39	5
40 to 46	6
47 to 53	7
54 to 59	8
60 to 66	9
67 to 73	10
74 to 79	11
80 to 86	12
87 to 93	13
94 to 99	14
100 to 106	15
107 to 113	16
114 to 119	17
120 to 126	18
127 to 133	19
134 to 139	20
140 to 146	21

c. Terminal Train Brake Tests (1) The train must be charged to the required pressure. (Air pressure regulating devices on freight locomotives and cars must be adjusted for the following standard pressures: brake pipe, 80 pounds main reservoir, 140 pounds) Retaining valves and retaining-valve 'pipes on freight cars must be inspected and

known to be in proper condition for service. Airhose, handles of angle cocks, and cutout cocks must be in proper position. Careful examination must be made for leaks. Necessary repairs must be made to reduce leakage to a minimum. Before a train leaves an originating terminal, it must be charged and tested as prescribed by current rules, and where practical, should be kept charged until the road locomotive is coupled on.

(2) When a train is charged and tested from a yard test plant, either the locomotive brake valve should be used or a suitable testing device which provides for the increase and reduction of brake pipe pressure at the same or a slower rate than a locomotive brake valve. The testing device should be connected, when practicable, at the same point in the train at which the locomotive is to be attached.

(3) When it is known that the brake system is charged to within 5 pounds of standard brake pipe pressure for freight trains, a 15-pound service brake pipe reduction must be made on a signal to apply brakes Inspectors will note the amount of brake pipe leakage, which must not exceed 5 pounds in 1 minute as indicated by the brake pipe gage. After this test, reduction must be increased to 25 pounds. Inspectors will then examine the train brakes to determine whether the brakes are applied in a service application on each car, that piston travel is as prescribed, and that brake rigging does not bind or foul The Inspectors must then give a signal for releasing

(4) A train, having been charged and tested (from a yard plant, must be kept charged until the road locomotive is coupled on. The engineman taking the train out must, on a signal to apply brakes, make, a service brake pipe reduction of 15 pounds and determine by the length and force of the brake pipe discharge whether there is open communication throughout the brake pipe Inspectors will then note the amount of brake pipe leakage, which must not exceed 5 pounds in 1 minute as indicated by the brake pipe gage with its brake valve in lap position. After this test, the reduction must be increased to 25 pounds Inspectors must note whether the head end brakes of the train apply. They then signal for a release, noting whether the rear brakes release.

(5) When a train has been charged and tested from a yard plant and is not kept charged until the road locomotive is coupled on, brakes must be tested. After the brake system on a train has been charged to within 5 pounds of standard pressure for that train, as indicated by the brake pipe gage with brake valve in lap position, the outgoing engineman must, on a signal to apply brakes, make a service brake pipe reduction of 15 pounds to determine by the length and force of the brake pipe discharge whether there is open communication throughout the brake pipe. Inspectors will then note the amount of brake pipe leakage, which must not exceed 5 pounds in 1 minute as indicated on the brake pipe gage. After this test, reduction must be increased to 25 pounds. Inspectors will then examine the train brakes to determine whether the brakes are applied in a service application on each car. When this examination has been completed, the proper release signal must be given and each brake examined to see that it releases properly.

(6) When a train has not been charged and tested from a yard test plant, it must be charged and tested from the outgoing locomotive after the train has been completely assembled and the locomotive has been coupled on After the brake system on a freight train has been charged to within 5 pounds of standard brake pipe pressure as indicated by a gage at the rear of the train, the outgoing engineman, on a signal to apply brakes, must lap the brake valve until the brake pipe pressure settles. He must then make a 15 pound service reduction and determine by the length and force of the brake pipe discharge whether there is open communication throughout the brake pipe. Inspectors will note the amount of brake pipe leakage, which must not exceed 5 pounds In 1 minute as indicated on the brake pipe gage After this test, the reduction must be increased to 25 pounds. Inspectors will examine the train brakes to determine that the brakes are applied to each car, that piston travel is as prescribed, and that the brake rigging does not bind or foul Inspectors must then give the engineman the proper signal for releasing the brakes and see that all brakes release properly.

(7) When a test has been completed, the inspectors who made the test personally inform the engineman and the conductor of the test results and advise them of the number of cars in the train and the number having inoperative brakes. Before a train is started from a terminal, the inspectors must know that all handbrakes are released and that pressure-retaining valve handles are in proper position.

(8) The foreman of inspectors and the inspectors are jointly responsible for the condition of the airbrakes and train air equipment on cars leaving their station.

d. Road Train Brake Tests

(1) At the point where motive power or engine crew or train crew is changed, tests must be made of the train brake system. After the brake system on a freight train has been charged to within not less than 5 pounds below the standard brake pipe gage with the brake valve in lap position, the engineman must make a 15-pound service reduction upon proper request or signal and note the amount of brake pipe leakage as indicated by the brake pipe gage (which must not exceed 5 pounds per minute). After this test, the reduction must be increased to 25 pounds. Then, an examination of the train brakes must be made to determine whether brakes apply in a service application on each car. When this examination has been completed, the proper release signal must be given and each brake must be examined to see that it releases properly.

(2) On a freight train, before a locomotive is detached or an angle cock is closed on a locomotive or car, the train brakes must be applied with a full service brake application. After recoupling, opening the angle cocks, and releasing the train brakes, but before proceeding, a 25 pound service reduction must be made. Inspectors will note whether the rear brakes of the train apply and then signal for a release, noting whether rear brakes release.

(3) When a locomotive or locomotives are ,added to a freight train, after coupling on and opening the angle cocks, but before proceeding, a 25-pound service reduction must be made Inspectors will note whether brakes on the cars at the rear of the train apply and then signal for a release, noting whether the rear brakes release.

e. Airbrakes Tests on Arriving Trains. Freight trains arriving at terminals where facilities are available for immediate brake inspection and repairs shall be left with airbrakes applied with a total service brake pipe reduction of at least 10 pounds. Trainmen must close the angle cocks on the head and rear cars before cutting off the locomotive or caboose. Inspection of brakes and needed repairs must be made as soon thereafter as practicable. Where inspectors are employed to make a general inspection of cars upon arrival at a terminal, they must make a visual inspection of retaining valves, release valves and rods, retaining-valve pipes, brake rigging, handbrakes, hose, and the position of angle cocks, and make necessary repairs or mark for repair tracks any cars to which repairs cannot be made promptly.

16-7. Periodic Repairs

a. Airbrake equipment on railway cars must be cleaned, repaired, lubricated, and tested as often as required to maintain it in a safe and suitable condition for service, but not less frequently than as prescribed below.

(1) *Freight cars:*

(a) AB type brake, including AB type brake cylinders, 48 months as indicated by stenciled date on car.

(b) Other brake equipment, 15 months.

(c) When a freight car having brake equipment not due for periodic attention as indicated by airbrake cleaning stencil is on shop or repair track, brake equipment must be tested by single car testing device (fig 8-41) as prescribed by currently effective AAR Code of Tests, providing such car has not been so tested within the previous 90 days as indicated by airbrake cleaning or in-date testing stenciling on the car. Proper method of stenciling is illustrated in figure 819.

(2) *Passenger cars:*

(a) D-22 type brake, 24 months.

(b) UC-type brake, 15 months.

(c) All other types, 12 months.

b. Missing pipe clamps must be replaced, and loose ones must be tightened. Hose and angle cocks must be properly positioned. Piston travel must be adjusted If required.

c. Handbrakes and connections must be inspected, lubricated, and tested and necessary repairs made to insure that they are in suitable condition for safe and effective operation.

d. Complete AB type freight car brake equipment and high-speed passenger car brake equipment must be cleaned, repaired, lubricated as required, and tested as prescribed by manufacturer's instruction pamphlets available through the US Army Mobility Equipment Command, St. Louis, Mo.

e. Brake cylinders other than the AB type must be cleaned, repaired, lubricated as required, and tested as prescribed below.

(1) Brakes must be made inoperative before work is done on brake cylinders. This is accomplished by closing the cutout cocks in the brake pipe branch pipes and draining all reservoirs. When cutout cocks are provided in the brake cylinder pipes, only these cutout cocks must be closed. The reservoirs need not be drained.

(2) Piston rods must first be secured to nonpressure cylinder heads, after which nonpres-

sure heads, piston rod, piston heads, and release springs must be removed and thoroughly cleaned by scraping off all deposits of grease and dirt and by removing rust spots from piston rods and cylinder walls using sandpaper preferably, or emery cloth, if necessary Grease and dirt must also be removed from leakage grooves. All parts must be thoroughly cleaned (with cleaning solution, if necessary) and must be dried with a cloth before being reassembled.

(3) Excessively worn piston packing cups must be renewed. Packing cups slightly worn at 'one location but otherwise in good condition may be used by rotating cups so that the worn side is at the top of the cylinder. Packing cups must be applied centrally on piston heads. Follower studs in piston heads of other than U-type brake cylinders must be tight, and nuts must be tightened uniformly.

(4) The inner walls of cylinders and the bearing surfaces of piston packing cups must [have a thin coating of approved brake cylinder ,lubricant applied with a brush The grease groove of the piston lubricator swab must also be filled with this lubricant

(5) Sharp tools must not be used in insert ing piston assemblies in cylinders After piston assemblies have been inserted in cylinders, but before nonpressure heads are applied, piston rods must be rotated slightly to avoid damage to packing cups and to determine that assemblies are free and do not bind.

(6) After brake cylinders have been reassembled on cars, a leakage test must be made ,strictly in accordance with the approved, currently effective, single-car code of tests.

f. Miscellaneous inspections and repairs include the following:

(1) Brake pipe, branch pipe, and pipe 'bracket must be thoroughly blown out, and the strainer in the branch pipe, triple valve, or control valve must be cleaned The dirt collector must be thoroughly cleaned by removing the bowl or plug. Before the plug or flange bolts are reapplied, threaded portions must be coated with oil and graphite or graphite grease. The dirt collector must be applied in a vertical position with the bowl at the bottom.

(2) Should any of the triple-valve or control-valve bushings require renewing, such work must be done in the airbrake shop.

(3) Standard gaskets must be used Gaskets of irregular thickness or those having improper registry of ports must be rejected.

(4) Slack adjusters, other than an air-operated type, must be adjusted to provide piston travel standard to the car, see (9) and *k* below.

(5) Automatic slack adjusters on cars must be cleaned, repaired, lubricated, adjusted, and tested as often as conditions require and not less 4 frequently than triple valves or control valves are cleaned and repaired.

(6) Air-operated slack adjuster screws must first be moved full travel toward the brake cylinder end of the adjuster bodies by turning the ratchet nuts. After removing the crosshead pin cups and pins, engines and screws must be removed. Screws must then be thoroughly cleaned with a wire brush. Engines must be disassembled, thoroughly cleaned, and inspected to determine repairs and new parts required. All parts except ,piston packing cups and gaskets must be thoroughly cleaned with cleaning solution, blown with compressed air, and dried with a cloth. Packing cups must be removed before pistons are cleaned with solution and must be renewed when necessary. Packing cups and gaskets must be cleaned only with a dry cloth. Defective packing cups and gaskets must be replaced only with standard parts. All parts must be blown with compressed air, and air passages must be free of obstructions. Springs must meet standard requirements and must be renewed when necessary.

(7) Piston lubricator swabs must be removed and left out of cylinder. Ratchets, pawls, and appurtenances, and packing cups must be lubricated with approved brake cylinder lubricant.

(8) Lubrication of slack adjuster screws is limited to a small quantity of dry graphite applied in the hollow of the ratchet nuts

(9) After slack adjuster cylinders have been reassembled, screws and engines have been applied, and screws are in full-travel position toward brake cylinder ends of adjuster bodies, prescribed piston travel must be provided by the use of manual slack adjusters or by moving the pin to the proper hole in the brake adjusting rod. Piston travel must be adjusted to allow 1/2 inch in excess of prescribed travel, and the position of ratchet nuts will be indicated by marking nuts and housings A service application of brakes must be made. After the pipes leading from the brake cylinders to the slack adjusters have been checked for leakage and after the brakes have been released, a movement of the ratchet nuts from their marked positions indicates that the slack adjusters are in proper operating condition.

g. After periodic attention has been given airbrake equipment on freight cars, old stenciled cleaning dates must be obliterated and new dates stenciled in accordance with requirements of current rules

h. Retaining valves must be thoroughly cleaned with cleaning solution by removing valve caps, wraps excluder, and valves. Vent ports and drilled passages must be inspected for obstructions caused by pipe scale, dirt, or wasp activities and to determine visible defects Small amounts of graphite grease must be applied to the threads -of retaining-valve caps when they are being reassembled. The strainer in a four-position type retaining-valve bracket must be thoroughly cleaned by being blown with compressed air, and, if defective, must be replaced Retaining valves must be adequately secured in a vertical position and handles must move freely.

i. Retaining valves and retaining-valve pipes on cars must be tested as prescribed by approved manufacturer's code of tests.

j. Brake pipe hose which has been removed from passenger cars may be reused on freight cars if such hose satisfactorily passes inspection. If a hose is not condemned and is to be reused on a freight car, visual inspection must be made of its inner lining by placing the opening In the coupling against a frosted, 150-watt electric light bulb and sighting through the nipple end. If the lining does not appear to be damaged, a steel ball of 3/4-inch diameter must be passed through the hose assembly, including the gasket, to determine whether the hose is obstructed After this test, the hose must be subjected to a pressure test of 140 pounds either while submerged In water oil while entirely coated with soapsuds airbrake hose must be replaced if over 8 years old or the date is obliterated

k . Brakeshoes will be removed when worn to 1/4 inch or less in thickness, next to the flange. Piston travel must be adjusted by hand, or by the slack adjuster, when brakeshoes are renewed. The piston travel must be sufficient to provide proper show clearance when the brakes are released, but with a full service brake application, must be adjusted within the limits of 7 to 9 inches. Before piston travel IS adjusted on cars, or before work is done on brake rigging or parts adjacent to brake rigging on a car in a train when the train line is charged, the cutout cock in the branch pipe must be closed The reservoir draincocks and release valves must remain open until the work is completed.

l. Single-pressure type retaining valves with bypass chokes on passenger cars must be tested with 50 pounds of initial cylinder pressure with the handle in a horizontal position After this test, brake cylinder air pressure must release In approximately 1 minute after triple or control valves have been moved to release position.

CHAPTER 17

INSPECTION FORMS

17-1. General

Authorized forms pertinent to the inspection and maintenance of railway cars are listed in Department of the Army Pamphlet (DA Pam) 310-2, Index of Blank Forms. Most of these forms are designed for use by a transportation (military) railway service in an oversea theater, but many are suitable for use by installation transportation officers and other agencies concerned in the inspection, maintenance, and repair of Army-owned railway cars in the continental United States (CONUS) Discussion and illustrations contained herein are intended for the general guidance of responsible officers and subordinate inspectors. All forms are not illustrated because of space limitations; those shown are included as being of the most interest and applicability to present-day operations. All forms will be requisitioned through normal supply channels except those which are stocked and issued by the Adjutant General, US Army Transportation Center, Fort Eustis, Virginia 23604.

17-2. DA Form 55-126 (Request and Receipt for Spare Parts, Supplies, Services, or Repairs for US Army Hospital Cars from Railroads)

a. Supplies of this form will be carried on all ambulance, guard, or kitchen cars to be completed by the train commander or responsible transportation officer, in quadruplicate, when it is necessary to secure supplies or services from railroads. The original and one copy will be provided the railroad representative; the third copy forwarded to the US Army Materiel Command (AMC), Washington, D. C. 20310; the fourth copy will be retained by the agency to which the car(s) is assigned.

b. The Commanding General, US Army Materiel Command, will be responsible for processing all bills for spare parts, supplies, repairs, and services furnished by railroads in CONUS for ambulance guard and troop kitchen cars owned by the department of the Army (DA).

(1) The railroads will submit invoices in quadruplicate, together with the original copy of DA Form 55-126, to the Commanding General, US Army Mobility Equipment Command, St. Louis, Missouri 63166, or such other agency as the Commanding General, 'US Army Materiel Command, may designate.

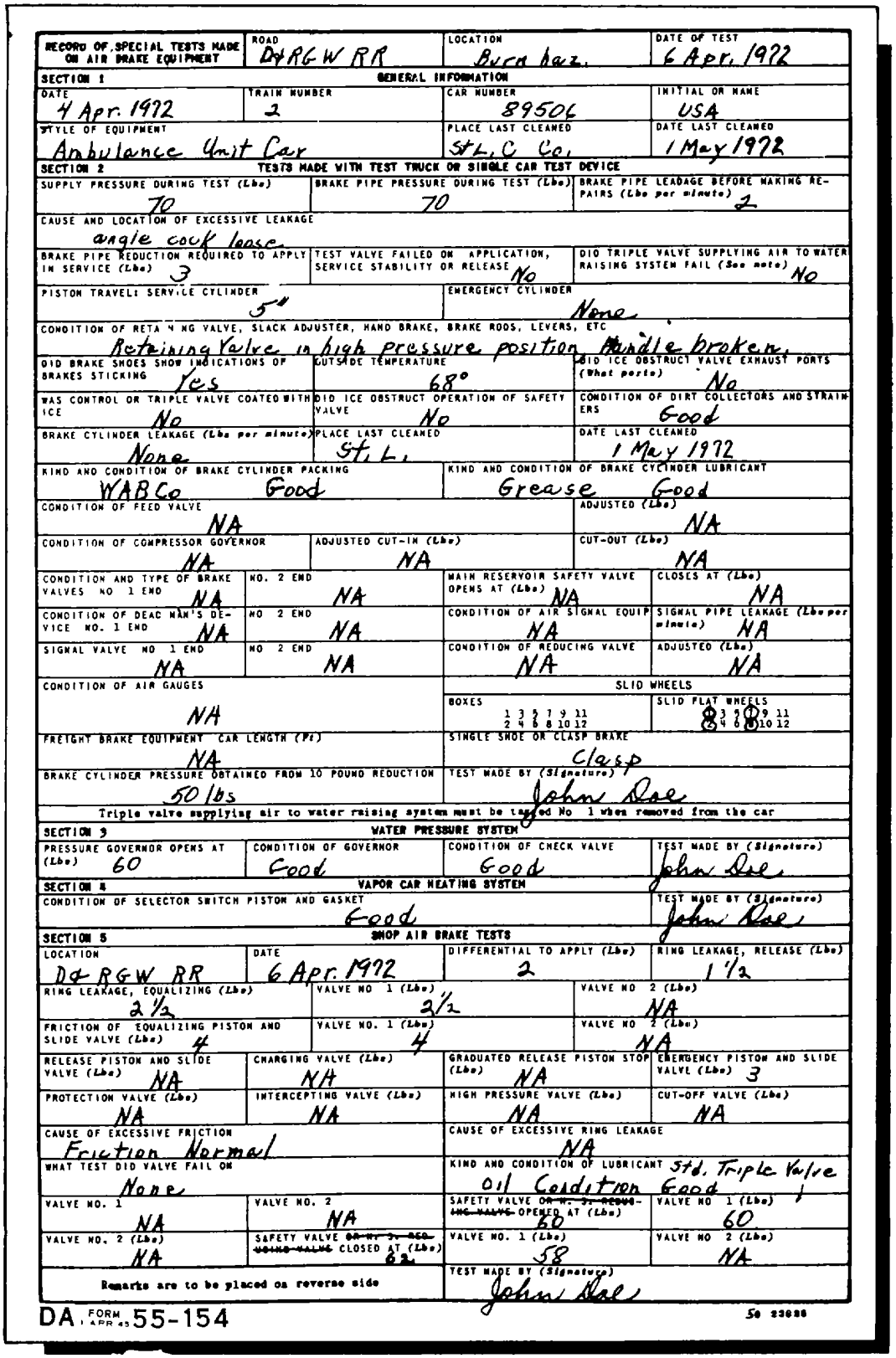
(2) The responsible agency will check all invoices submitted to insure that they are in accordance with applicable regulations and the Association of American Railroads (AAR) Code of Rules governing the condition of and re-pairs to passenger type railway cars in interchange. Such invoices will then be processed for payment by the appropriate finance disbursing officer.

17-3. DA Form 55-154 (Record of Special Tests Made on Airbrake Equipment)

DA Form 55-154 (fig 17-1) will be completed in triplicate by the person in charge of testing equipment whenever cars develop faulty airbrakes which cause delay to trains or damage to wheels. Item on this form pertaining to the condition of the feed valve, compressor-governor, brake valves, main reservoir safety valve, deadman's device, air signal valve, reducing valve, and air gages will be completed only when rail motorcars or other types of self-propelled cars equipped with airbrakes are tested. These items will not be filled in when freight or passenger cars are tested. In theaters of operations, one copy will be forwarded to the commanding officer of the railway operating battalion and one copy to transportation railway group headquarters. In the continental United States, one copy will be retained on file at the installation and two copies will be forwarded to the Commanding General, US Army Mobility Equipment Command.

17-4. DA Form 55-156 (Battery Removal and Application Record)

This form (fig 17-2) will be completed in duplicate by the person in charge of removing batteries from and installing batteries in cars



RECORD OF SPECIAL TESTS MADE ON AIR BRAKE EQUIPMENT

ROAD	LOCATION	DATE OF TEST
D&RGW RR	Burn Haz.	6 Apr. 1972

SECTION 1 — GENERAL INFORMATION

DATE	TRAIN NUMBER	CAR NUMBER	INITIAL OR NAME
4 Apr. 1972	2	89506	USA
STYLE OF EQUIPMENT		PLACE LAST CLEANED	DATE LAST CLEANED
Ambulance Unit Car		St. L. Co.	1 May 1972

SECTION 2 — TESTS MADE WITH TEST TRUCK OR SINGLE CAR TEST DEVICE

SUPPLY PRESSURE DURING TEST (Lbs)	BRAKE PIPE PRESSURE DURING TEST (Lbs)	BRAKE PIPE LEAKAGE BEFORE MAKING REPAIRS (Lbs per minute)
70	70	2

CAUSE AND LOCATION OF EXCESSIVE LEAKAGE: angle cock loose.

BRAKE PIPE REDUCTION REQUIRED TO APPLY IN SERVICE (Lbs)	TEST VALVE FAILED ON APPLICATION, SERVICE STABILITY OR RELEASE	DID TRIPLE VALVE SUPPLYING AIR TO WATER RAISING SYSTEM FAIL (See note)
3	No	No

PISTON TRAVEL: SERVICE CYLINDER	EMERGENCY CYLINDER
5"	None

CONDITION OF RETAINING VALVE, SLACK ADJUSTER, HAND BRAKE, BRAKE RODS, LEVERS, ETC: Retaining Valve in high pressure position, Handle broken.

DID BRAKE SHOES SHOW INDICATIONS OF BRAKES STICKING	OUTSIDE TEMPERATURE	DID ICE OBSTRUCT VALVE EXHAUST PORTS (What ports)
Yes	68°	No

WAS CONTROL OR TRIPLE VALVE COATED WITH ICE	DID ICE OBSTRUCT OPERATION OF SAFETY VALVE	CONDITION OF DIRT COLLECTORS AND STRAINERS
No	No	Good

BRAKE CYLINDER LEAKAGE (Lbs per minute)	PLACE LAST CLEANED	DATE LAST CLEANED
None	St. L.	1 May 1972

KIND AND CONDITION OF BRAKE CYLINDER PACKING	KIND AND CONDITION OF BRAKE CYLINDER LUBRICANT
WABCo Good	Grease Good

CONDITION OF FEED VALVE	ADJUSTED (Lbs)
NA	NA

CONDITION OF COMPRESSOR GOVERNOR	ADJUSTED CUT-IN (Lbs)	CUT-OUT (Lbs)
NA	NA	NA

CONDITION AND TYPE OF BRAKE VALVES NO 1 END	NO. 2 END	MAIN RESERVOIR SAFETY VALVE OPENS AT (Lbs)	CLOSES AT (Lbs)
NA	NA	NA	NA
CONDITION OF DEAD MAN'S DEVICE NO. 1 END	NO 2 END	CONDITION OF AIR SIGNAL EQUIP	SIGNAL PIPE LEAKAGE (Lbs per minute)
NA	NA	NA	NA
SIGNAL VALVE NO 1 END	NO 2 END	CONDITION OF REDUCING VALVE	ADJUSTED (Lbs)
NA	NA	NA	NA

CONDITION OF AIR GAUGES	SLID WHEELS: BOXES	SLID FLAT WHEELS
NA	1 3 5 7 9 11 / 2 4 6 8 10 12	3 5 7 9 11 / 4 6 8 10 12

FREIGHT BRAKE EQUIPMENT CAR LENGTH (Ft)	SINGLE SHOE OR CLASP BRAKE
NA	Clasp

BRAKE CYLINDER PRESSURE OBTAINED FROM 10 POUND REDUCTION	TEST MADE BY (Signature)
50 lbs	John Doe

Triple valve supplying air to water raising system must be tagged No 1 when removed from the car

SECTION 3 — WATER PRESSURE SYSTEM

PRESSURE GOVERNOR OPENS AT (Lbs)	CONDITION OF GOVERNOR	CONDITION OF CHECK VALVE	TEST MADE BY (Signature)
60	Good	Good	John Doe

SECTION 4 — VAPOR CAR HEATING SYSTEM

CONDITION OF SELECTOR SWITCH PISTON AND GASKET	TEST MADE BY (Signature)
Good	John Doe

SECTION 5 — SHOP AIR BRAKE TESTS

LOCATION	DATE	DIFFERENTIAL TO APPLY (Lbs)	RING LEAKAGE, RELEASE (Lbs)
D&RGW RR	6 Apr. 1972	2	1 1/2

RING LEAKAGE, EQUALIZING (Lbs)	VALVE NO 1 (Lbs)	VALVE NO 2 (Lbs)
2 1/2	2 1/2	NA
FRICTION OF EQUALIZING PISTON AND SLIDE VALVE (Lbs)	VALVE NO. 1 (Lbs)	VALVE NO 2 (Lbs)
4	4	NA

RELEASE PISTON AND SLIDE VALVE (Lbs)	CHARGING VALVE (Lbs)	GRADUATED RELEASE PISTON STOP (Lbs)	EMERGENCY PISTON AND SLIDE VALVE (Lbs)
NA	NA	NA	3
PROTECTION VALVE (Lbs)	INTERCEPTING VALVE (Lbs)	HIGH PRESSURE VALVE (Lbs)	CUT-OFF VALVE (Lbs)
NA	NA	NA	NA

CAUSE OF EXCESSIVE FRICTION	CAUSE OF EXCESSIVE RING LEAKAGE
Friction Normal	NA
WHAT TEST DID VALVE FAIL ON	KIND AND CONDITION OF LUBRICANT Std. Triple Valve Oil Condition Good
None	

VALVE NO. 1	VALVE NO. 2	SAFETY VALVE ~~OR N. Y. REGULATING VALVE~~ OPENED AT (Lbs)	VALVE NO 1 (Lbs)
NA	NA	60	60
VALVE NO. 2 (Lbs)	SAFETY VALVE ~~OR N. Y. REGULATING VALVE~~ CLOSED AT (Lbs)	VALVE NO. 1 (Lbs)	VALVE NO 2 (Lbs)
NA	62	58	NA

Remarks are to be placed on reverse side

TEST MADE BY (Signature): John Doe

DA FORM APR 45 55-154

50 23038

Figure 17-1. DA Form 55-154 (Record of Special Tests Made on Airbrake Equipment).

equipped with electric lighting systems. One copy will be kept on file at the Installation and one copy will be forwarded to the transportation railway headquarters In theaters of operations or to the US Army Mobility Equipment Command in CONUS.

17-5. DA Form 55-158 (Hospital Car Inspection and Repair Record)

This form (fig 17-3 (1) and 17-3 (2)) is a progressive record of inspection and repairs given DA ambulance cars and will be maintained on the car at all times In a suitable holder located on the back of the electrical-locker door. The inspectors will initial each item inspected, and the person in charge will sign his full name under that of the Inspector. When a card is completed, it will be sent to the headquarters, railway group, in theaters of operations or to the US Army Mobility Equipment Command In CONUS. A newer card will then be placed on the locker door.

17-6. DA Form 55-160 (Record of Cleaning Water Tanks on Hospital and Kitchen Cars)

This form (fig 17-4) will be maintained to indicate when water tanks and drinking-water containers were drained and cleaned and will be carried in holders provided for that purpose in all ambulance and kitchen cars. When water tanks are sterilized or before cars are released from a shop, a notation, "Sterilized," with the date, will be made under the caption, "Water Tanks." Records on this form will be entered by the foreman in charge or by the person doing the work immediately after work is completed. After the card has been filled completely, it will be removed and filed for further reference in the office of the foreman in charge. A fresh card will then be inserted in the holder.

17-7. DA Form 55-161 (Airbrake Defect Tags)

This form (fig 17-5) will be used by a car inspector or a train conductor to tag a car having inoperative brakes so that the defective condition will be noticed readily. Inspectors or conductors finding brakes inoperative will note the defect on the back of the card and attach the card to the brake pipe close to the triple valve In CONUS, inspectors or other personnel after completing repairs, will make a "repairs made" notation on the card and forward It to the officer in charge at the installation In theaters of operations, the inspector or other personnel, after completing repairs, will make a similar notation and forward the card to the officer In charge of airbrake repairs in the railway operating battalion

17-8. DA Form 55-162 (Inspector's Record)

This form (fig 17-6) will be used by car inspectors to report all defects on cars inspected by

DA FORM 1 APR 45 55-156

BATTERY REMOVAL RECORD

Date 3 Feb 72 Set No 2

Make Delta

Capacity 64 Volts

Mfr's type XXX

No of trays 16

Removed from car USA 89570

Location Fort Eustis, Va.

Signed Robert Roe
Sgt. 763rd Tr,Bn. Foreman

GPO 875 103

BATTERY APPLICATION RECORD

Date 3 Feb 72 Set No 2

Make Delta

~~New~~ Cleaned ~~Repaired~~ ~~Equalized~~ Rebuilt

Capacity 64 Volts

Mfr's type XXX

Order No 167 Date New 3 Feb 72

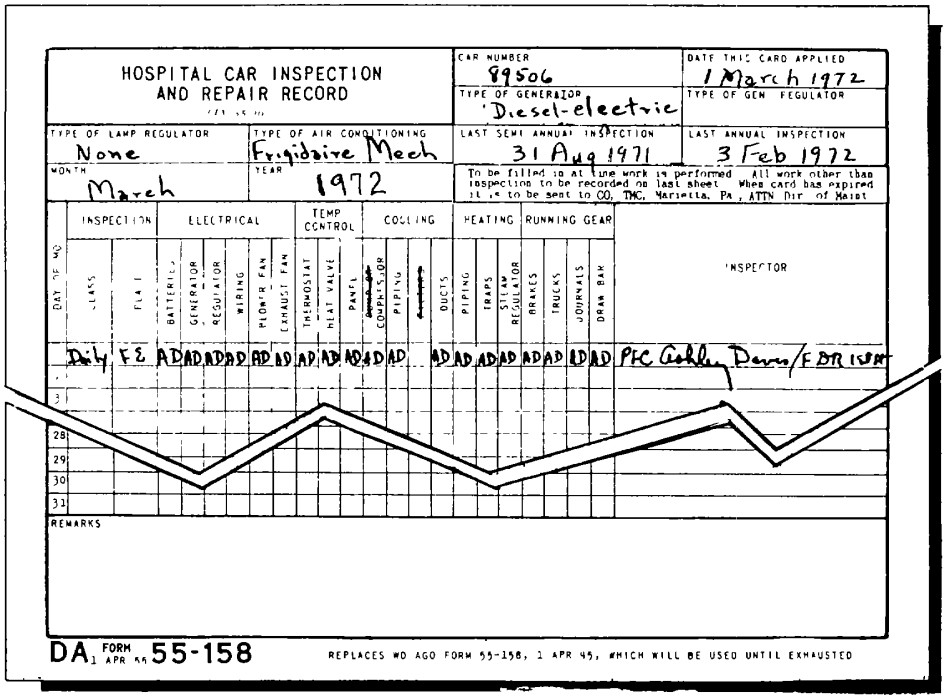
Applied to car USA 89570

Location Fort Eustis, Va.

Signed Robert Roe
Sgt. 763 Tr. Bn. Foreman

GPO 875 103

Figure 17-2. DA Form 55-156 (Battery Removal Record, Battery Application Record).



HOSPITAL CAR INSPECTION AND REPAIR RECORD

CAR NUMBER: 89506
DATE THIS CARD APPLIED: 1 March 1972
TYPE OF GENERATOR: Diesel-electric
TYPE OF GEN REGULATOR:
TYPE OF LAMP REGULATOR: None
TYPE OF AIR CONDITIONING: Frigidaire Mech
LAST SEMI ANNUAL INSPECTION: 31 Aug 1971
LAST ANNUAL INSPECTION: 3 Feb 1972
MONTH: March
YEAR: 1972

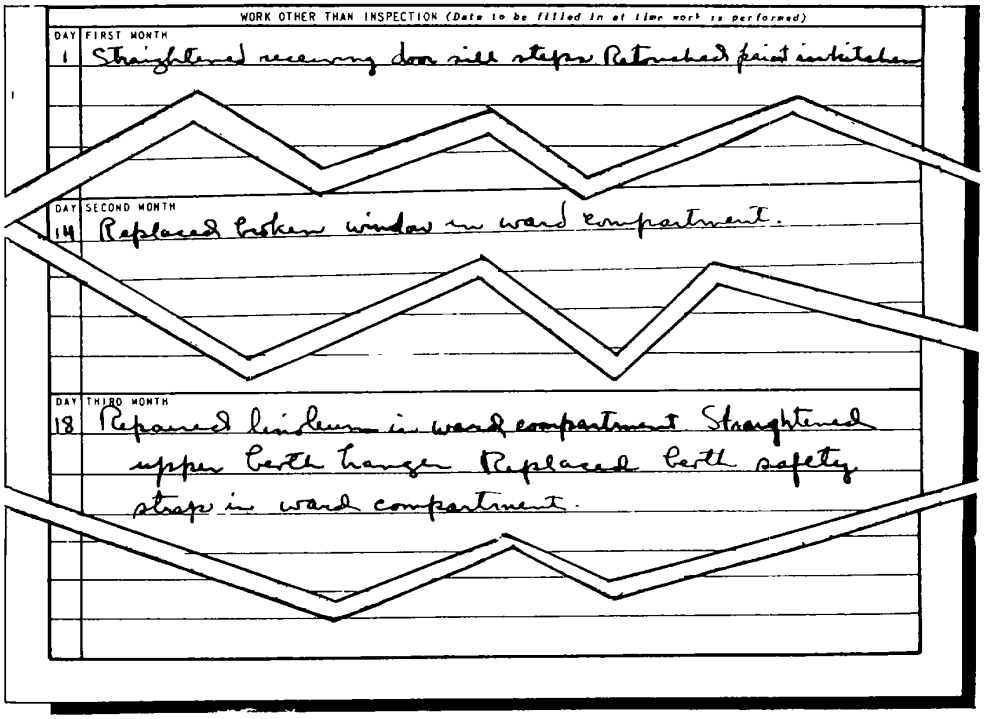
To be filled in at time work is performed. All work other than inspection to be recorded on last sheet. When card has expired it is to be sent to CO, TMC, Marietta, Pa., ATTN Dir. of Maint.

DAY OF MO	INSPECTION: CLASS	INSPECTION: FILE	ELECTRICAL: BATTERIES	ELECTRICAL: GENERATOR	ELECTRICAL: REGULATOR	ELECTRICAL: WIRING	ELECTRICAL: BLOWER FAN	ELECTRICAL: EXHAUST FAN	TEMP CONTROL: THERMOSTAT	TEMP CONTROL: HEAT VALVE	COOLING: PANEL	COOLING: COMPRESSOR	COOLING: PIPING	COOLING:	COOLING: DUCTS	HEATING: PIPING	HEATING: TRAPS	HEATING: STEAM REGULATOR	RUNNING GEAR: BRAKES	RUNNING GEAR: TRUCKS	RUNNING GEAR: JOURNALS	RUNNING GEAR: DRAW BAR	INSPECTOR
Daily	FE	AD	AD	AD	AD	AD	AD	AD	AD	AD	AD	AD	AD		AD	AD	AD	AD	AD	AD	LD	AD	PIC Gebby Davis/FBR 15 MAR
3																							
28																							
29																							
30																							
31																							

REMARKS

DA FORM 1 APR 55 55-158 REPLACES WD AGO FORM 55-158, 1 APR 45, WHICH WILL BE USED UNTIL EXHAUSTED

Figure 17-3(1). DA Form 55-158 (Hospital Car Inspection and Repair Record) (front). (Second and third pages are same as front page.)



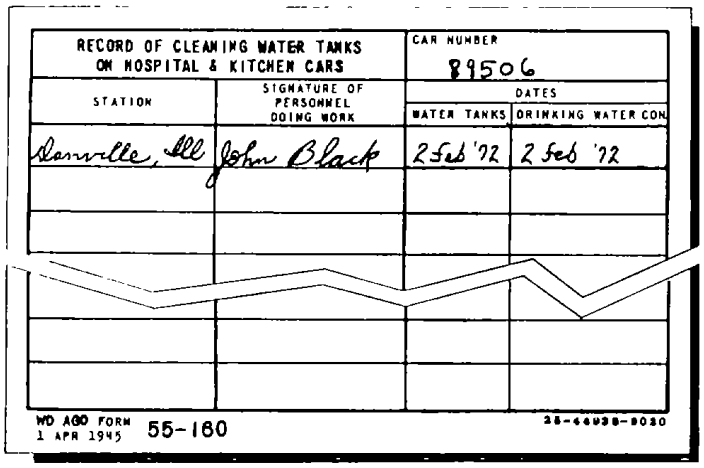
WORK OTHER THAN INSPECTION (Date to be filled in at time work is performed)

DAY 1 FIRST MONTH: Straightened receiving door sill steps Patched and paint imitated

DAY 14 SECOND MONTH: Replaced broken window in ward compartment.

DAY 18 THIRD MONTH: Repaired linoleum in ward compartment Straightened upper berth hanger Replaced berth safety straps in ward compartment.

Figure 17-3(2). DA Form 55-158 (Hospital Car Inspection and Repair Record) (fourth page).



RECORD OF CLEANING WATER TANKS ON HOSPITAL & KITCHEN CARS

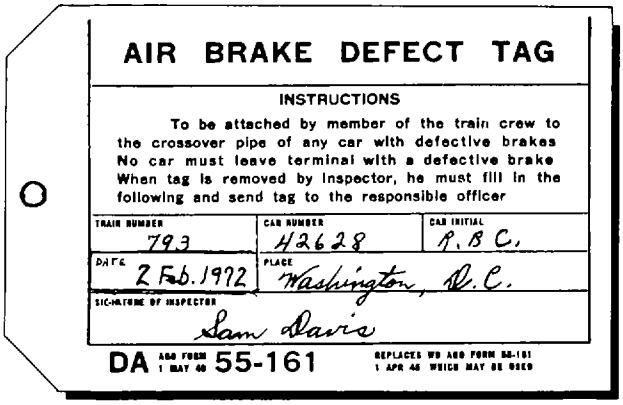
CAR NUMBER 89506

STATION	SIGNATURE OF PERSONNEL DOING WORK	DATES	
		WATER TANKS	DRINKING WATER CON
Danville, Ill	John Black	25 Feb '72	2 Feb '72

WD AGO FORM 1 APR 1945 55-160

Figure 17-4. DA Form 55-160 (Record of Cleaning Water Tanks Hospital and Kitchen Cars).

Figure 17-6. DA Form 55-162 (Inspector's Record).



AIR BRAKE DEFECT TAG

INSTRUCTIONS

To be attached by member of the train crew to the crossover pipe of any car with defective brakes No car must leave terminal with a defective brake When tag is removed by Inspector, he must fill in the following and send tag to the responsible officer

TRAIN NUMBER	CAR NUMBER	CAR INITIAL
793	42628	A.B.C.
DATE 2 Feb. 1972	PLACE Washington, D.C.	
SIGNATURE OF INSPECTOR Sam Davis		

DA AGO FORM 1 MAY 48 55-161 REPLACES WD AGO FORM 55-161 1 APR 43 WHICH MAY BE USED

Figure 17-5. DA Form 55-161 (Airbrake Defect Tag).

them and will include cars having defective handbrakes, cars carded to repair tracks, cars carded for reweighing, and cars inspected for other purposes. In theaters of operations, the completed form will be sent to the officer in charge of car repairs in the operating battalion. In CONUS, the completed form will be forwarded to the transportation officer at the installation where the inspections were made.

17-9. DA Form 55-163 (Car Inspector's Train Report)

This form (fig 17-7) will be used by the chief car inspector in reporting inspection of each train arriving or leaving the terminal or originating point where car Inspectors are located. In theaters of operations, this report will be retained on file by the officer in charge of car repairs in the railway operating battalion. In CONUS, the report will be retained on file at the installation.

17-10. DA Form 55-164 (Bad-Order Card)

This card (fig 17-8) will be completed by car inspectors or other personnel inspecting railroad rolling stock in train assembly yards or in other places where cars are checked to see if they are in a safe suitable condition for service. It is used to indicate equipment which needs repairs before further use.

a. Required information, which may be written in pencil, will include date, car number, nature of defect, place carded, and the name of the inspector, as well as whether the car is loaded or empty.

b. The side of the card having the words "Bad Order" on a black background will be used when the defective condition of a loaded car is such that it can be moved to a destination within the local switching district for unloading before repairs need to be made. This form may be used also when bad-order empty cars are forwarded from one shop or from one repair point to another for repairs.

c. Cards with the words "Bad Order" on a red background will be used to designate cars that are in such defective condition that they are not handled except to repair tracks.

d. Cards carry the words "light" and "heavy" ion each side. Marking one or the other of these words will indicate whether the car is to be placed on the light repair or the heavy repair track.

e. One card will be applied to each side of a bad-order car. On cars having wooden sides, the card will be placed below the car number. On cars with steel sides, cards will be placed on boards provided for this purpose.

f. Bad-order cards will not be removed from a car until repairs have been completed, and then only by authorized personnel. In both CONUS and theaters of operations, the inspector responsible for repairs will remove and destroy the cards when he determines a car is ready for service.

17-11. DA Form 55-165 (Conductor's Report of Damaged or Defective Cars)

This form (not shown) will be completed in duplicate by the conductor in charge of a train to provide the car inspector or foreman at the terminal with detailed information covering defects which developed while the cars were en route. One copy will be sent to the car foreman or inspector at the end of the trip, and one copy will be forwarded to the commanding officer of the railway operating battalion in theaters of operations or in the CONUS to the commanding officer, attention: installation transportation officer of the installation at which the car terminates.

17-12. DA Form 55-237 (Rolling Stock Specification Record)

This card (fig 17-9) will be used to provide information as to classification, type, capacity, gage, building, and other pertinent information for all rolling stock. When all cars of a group, type, or class are identical, only one card will be required for that group. A new card will be completed to indicate exceptions. If required data are not available, the information will be obtained from drawings and specifications or by an inspection of the car. A specification card for each car in service will be forwarded to the transportation railway group headquarters in theaters of operations or to the US Army Mobility Equipment Command in CONUS.

CAR INSPECTOR'S TRAIN REPORT — Train Number 42 — Engine Number 6600 — Station Mt Vernon — Date 6 Feb 72

INCOMING

Time of Arrival: 0600	Time Inspection Commenced: 0615
Time Inspection Completed: 0800	Air Brake Inspection Made: YES
By: George Stevens	
Top Inspected By: George Stevens	
Caboose Number: 44	Number of Cars in Train: 52
Number Cars Bad Order: None	Blue Signal Was Displayed: YES
Journal Boxes Were Inspected and Packing Adjusted: YES	
Remarks: None	
Sign Here of Inspector: George Stevens	Shift: 3d

OUTGOING

Time Train Called to Leave: 0815	Time Train Made Complete: 0745
Time Engine Coupled: 0745	Time Inspection Completed (Conductor must see to it): 0800
Time Engineman Set Brakes: 0750	Time Train Pulled: 0800
Time Train Departed: 0820	Yard Air Pressure Was Used on Train Before Engine Was Coupled: YES
If Not State Why: NA.	
Caboose Number: 44	Number of Cars in Train: 52
Number Cars Bad Order: None	Blue Signal Was Displayed: YES
Short Brake Pipe Leakage: None	Journal Boxes Inspected and Packing Adjusted: YES
Give Reason for Any Delay in Getting Train Out: None	
Signature of Inspector: George Evans	Shift: 1st

DA FORM 55-163

Figure 17-7. DA Form 55-163 (Car Inspector's Train Report).

DA FORM 55-164
1 APR 1945

SHOP ~~LIGHT~~ ~~HEAVY~~

To Washington Shop Shop

5 June 1972

16—44641-2 GPO

BAD ORDER

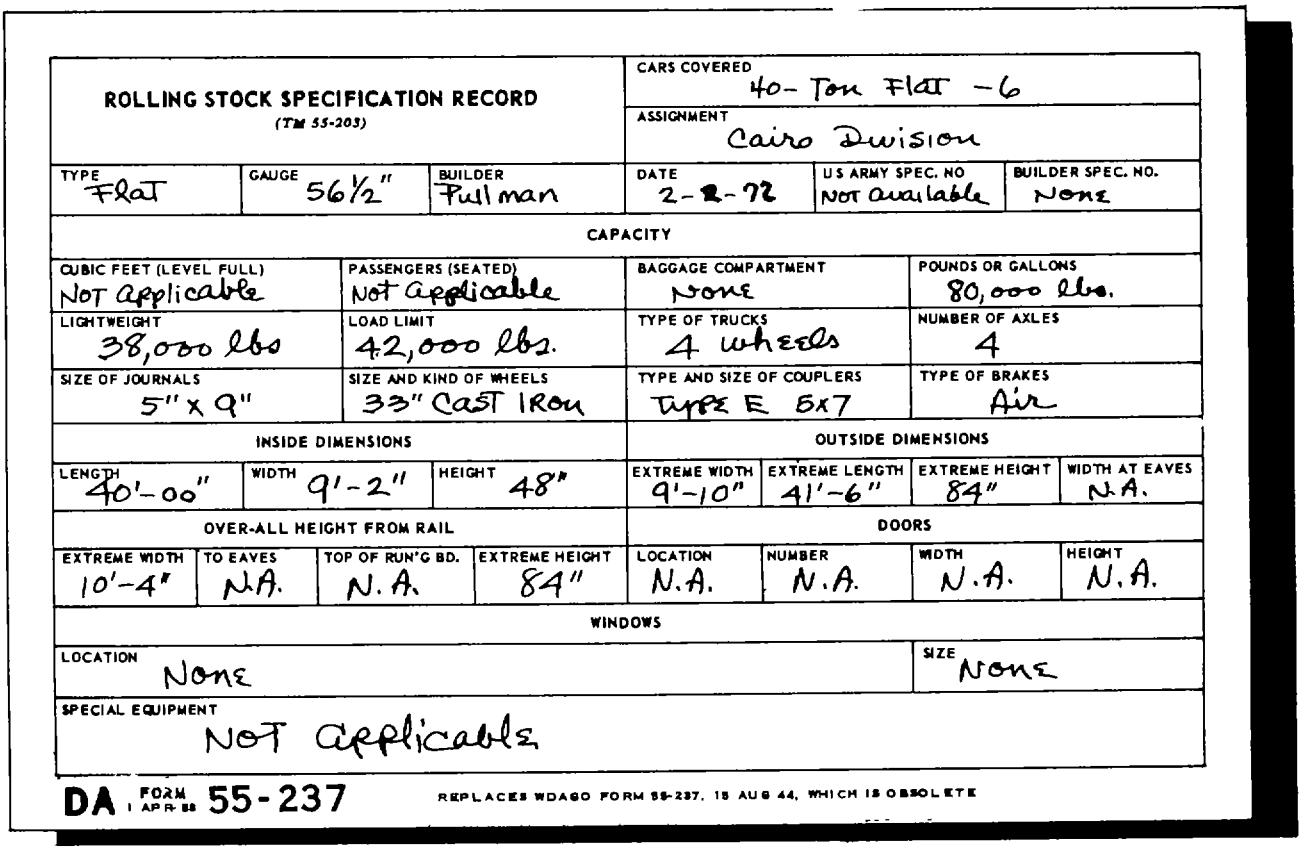
DEFECT No brake shoe

Car Initials A T & S No. 52345 Loaded or Empty Empty

Place Carded Blackburn Inspector George Smith

So State:—When damage is due to Derailment, Cornering, Sideswiping, Telescoping or other handling Line Responsibility Conditions.

Figure 17-8. DA Form 55-164 (Bad-Order Card).



ROLLING STOCK SPECIFICATION RECORD
(TM 55-203)

CARS COVERED: 40- Ton Flat -6
ASSIGNMENT: Cairo Division

TYPE	GAUGE	BUILDER	DATE	US ARMY SPEC. NO	BUILDER SPEC. NO.
Flat	56½"	Pullman	2-2-72	Not Available	None

CAPACITY

CUBIC FEET (LEVEL FULL)	PASSENGERS (SEATED)	BAGGAGE COMPARTMENT	POUNDS OR GALLONS
Not Applicable	Not Applicable	None	80,000 lbs.
LIGHTWEIGHT	**LOAD LIMIT**	**TYPE OF TRUCKS**	**NUMBER OF AXLES**
38,000 lbs	42,000 lbs.	4 wheels	4
SIZE OF JOURNALS	**SIZE AND KIND OF WHEELS**	**TYPE AND SIZE OF COUPLERS**	**TYPE OF BRAKES**
5" x 9"	33" Cast Iron	Type E 5x7	Air

INSIDE DIMENSIONS			OUTSIDE DIMENSIONS			
LENGTH	WIDTH	HEIGHT	EXTREME WIDTH	EXTREME LENGTH	EXTREME HEIGHT	WIDTH AT EAVES
40'-00"	9'-2"	48"	9'-10"	41'-6"	84"	N.A.

OVER-ALL HEIGHT FROM RAIL				DOORS			
EXTREME WIDTH	TO EAVES	TOP OF RUN'G BD.	EXTREME HEIGHT	LOCATION	NUMBER	WIDTH	HEIGHT
10'-4"	N.A.	N.A.	84"	N.A.	N.A.	N.A.	N.A.

WINDOWS

LOCATION	SIZE
None	None

SPECIAL EQUIPMENT: Not Applicable

DA FORM 1 APR 55 55-237 REPLACES WDAGO FORM 55-237, 15 AUG 44, WHICH IS OBSOLETE

Figure 17-9. DA Form 55-237 (Rolling Stock Specification Record).

17-13. DD Form 1335 (Inspection Report for Railway Cars)

a. General. This form (not shown) will be used in making maintenance inspections described thereon It can also be used to report damages to commercial railway-owned cars as discussed below Reports will be filed in the office of the inspector at the installation making the inspection, held for 1 year, then retired to the appropriate record holding office.

b. Damage, Commercial Railway Cars. If a car owned by a commercial railroad is damaged while the car is within the confines of a Government installation, including damage by collision, derailment, bad handling, or loading and unloading by DOD personnel, the ITO will make an inspection to determine the extent of the damage and to fix responsibility. If investigation discloses that the damage is the fault of installation personnel, payment for such damage is that installation's responsibility. The ITO will forward report of such investigation, with a copy of DD Form 1335, showing damage to the car, to the Installation Claims Officer for necessary handling with the owning railroad.

17-14. DA Form 2407 (Maintenance Request)

This form (not shown) will be used to report manufacturing, design, or operational defects in railway cars, and will be completed by the agency that is responsible for maintaining the equipment. In theaters of operation or other oversea areas, a copy will be forwarded to the transportation command or staff activity responsible for rail operations. In CONUS, the form will be prepared and forwarded as prescribed by TM1 38750, although this manual is not otherwise applicable to railway equipment

PART SIX

MAINTENANCE OPERATIONS AND FACILITIES

CHAPTER 18

SHOPS, HEAVY (DEPOT) MAINTENANCE

Section I. GENERAL

18-1. Transportation Railway Car Repair Company (TOE 55-248)

a. Mission. The mission of the transportation railway car repair company is-

(1) To perform general support maintenance on railway equipment.

(2) To receive, store, and issue 8,000 items of supply required for maintenance of railway rolling stock and diesel-electric locomotives and direct support of four to six railway battalions.

b. Capabilities. This company is capable of-

(1) Performing heavy maintenance involving stripping, fabricating, milling, painting, assembling, and erecting work for 2,500 cars.

(2) Operating a car wheel and axle shop.

(3) Pattern making, upholstering, canvas work, and machine operations on car parts.

(4) Assembling new or repaired freight, passenger, and special-purpose cars.

(5) Maintaining 600 railway cars per month.

c. Equipment. Normally, the TOE for this company will include only such equipment necessary to perform the above functions. In theaters of operations, the TOE equipment may be greatly augmented by facilities and equipment found in existing shops, particularly where damage to such shops is small.

18-2. Rehabilitation of Shops and Facilities, Theaters of Operations

A reconnaissance will be made to determine the best location for the car repair company. Search should be made at the division points or terminals for facilities which can be rehabilitated most rapidly with the personnel and materials at hand. Certain preliminary information secured through intelligence channels is necessary, including:

a. Purpose for which the railroad is required and availability of indigenous labor.

b. Tonnage capacity of the railroad.

c. Terminal points, division and intermediate

d. Number of cars, present and future.

e. Condition of cars.

f. Controlling points as determined by tactical and strategic considerations.

18-3. Stores, Theaters of Operations

a. For overseas military railway service, the significance of stores, particularly delivers scheduling, may be a matter of real concern since reliable maintenance experience factors have not been established to show the expected lift of individual component parts of cars. These factors for oversea equipment will concern wheels, brakeshoes, bearings, coupler parts, lubricants, journal packing, springs, doors, brake beams, and airbrake hose and connections.

b. Equipment arriving overseas cannot be cannibalized for replacement parts. Arriving cars are scheduled for service and will not be available as a source of parts supply. Stripping new cars will be permitted only in cases of extreme emergency. Stores planning for car maintenance is, therefore, a function that must be given serious consideration. DA Supply Catalog 22001L lists railway car accessories and components authorized for issue and local procurement in Federal Supply Classification Group 22, Railway Equipment, item 2240.

Section II. FREIGHT CARS

18-4. General

The following should be given careful consideration in planning a new or modified shop in a theater of operations:

a. The availability of land, buildings, labor, and material is an important factor. If shop buildings are available or can be converted, the car repair operation will be less vulnerable to interruptions or delays due to weather than if work is performed in the open.

b. Where practicable, even in a small operation, the facilities should be arranged for repair operations on one class of car, that is, designated tracks for one class at a time. This permits concentration of material and the installation of subassembly lines, platforms, racks, and devices for efficient repair operations.

c. The size of the shop will depend on the output that will be required from it. The tactical situation and seasonal demand may determine requirements, since it might be necessary to concentrate the heavy repair work on a certain class of car during a short light traffic period. Any available heavy repair shops may be used for the building or assembly of completely new cars, such as flatcars, boxcars, and gondola cars. The railway service may fabricate some major parts such as underframes, sides, ends, roof sections, hoppers, doors, and various subassemblies. These parts can be assembled into a complete car in a series of relatively simple operations and with limited shop facilities.

18-5. Heavy Repairs

a. Heavy repair work on varied and miscellaneous types of cars will consist of those operations requiring more than 3 days to complete. This will include repair or rebuilding of cars damaged in combat actions, wrecks, derailments, accidents, or by sabotage, as well as the necessary work on bad-order cars to upgrade or restore them to service for an additional period.

b. The facilities required for this type of general heavy repair work will be similar to those outlined for light car repairs and usually will include an open side of enclosed building; offices; wash, locker, and toilet rooms; blacksmith shop; fabricating shop; airbrake room; and a woodworking shop with related material storage building and platforms.

18-6. Estimating Material Needs

a. Where practicable in advance of the scheduled shipping date, a certain number of cars of a particular series should be forwarded to the heavy repair shop These cars should be stripped down and tabulation should then be made of the repairs and items needed and an average secured representing the quantity required for one car of a series. This average figure can then be used as an experience factor to set up a material estimate to cover the entire series. Preliminary inspections and repair work may indicate certain car parts which can be reclaimed or reworked successfully.

b. Necessary requisitions can be prepared and orders placed with supply personnel for delivery on a fixed schedule to coincide with repair operations. Car repair company supply officers should be cognizant of approximate times required to get materials from CONUS and submit requisitions accordingly. A careful check of material orders and deliveries must be made regularly during the repair period. It may be necessary to increase or reduce quantities of certain items if the repairs required are greater or less than were indicated by the average figure. Where deliveries of some items are delayed, special efforts can be made to expedite such shipment to prevent shutdown or delays in the repair shop operations.

c. Preliminary estimates of labor and material provide valuable data for preparation of forecasts of future repair shop operations.

18-7. Progressive Repair System

The scheduling of repairs to one or more series of cars on a program basis provides an opportunity for appreciable economies when such work is performed by a progressive or spot system. The progressive system is an adaptation in the railroad shop of the assembly line method used in automotive production plants. For the Army, it is well adapted to the erection of knocked down cars or to conversion programs such as the conversion of flatcars to lowside gondolas. Advantages result from increased production, since personnel can specialize in a particular operation; materials and tools can be located conveniently; and jigs, fixtures, and devices can be used for subassembly and final assembly. An important requirement is the provision of some means of moving a car or group of cars from one position to another, such as the use of gravity, car puller, or both.

18-8. Shop Procedure

a. The general procedure in the operation of a heavy repair facility on the progressive system will be somewhat as outlined below, subject to wide variations for different classes of cars.

b. The cars are spotted at one or more positions where they are stripped to the underframe or to the point where all corroded, defective, or broken steel or wooden parts are removed. This work is done by oxyacetylene torch. Cranes are used to remove scrap. Lumber should be piled and burned to eliminate handling.

c. The next general location provides means for cleaning the car and preparing it for the assembly line. Sandblasting, grit-blasting, acid cleaning, or hand-cleaning methods are used for this purpose. The cars are then moved to the painting area where they receive one or more prime coats of paint or a protective coating before the start of the assembly work.

d. Car bodies are removed from the trucks at some point on the assembly line and are moved by dummy trucks or supported on pedestals until rebuilt trucks can be applied. Truck overhaul is usually performed on a separate track or at a suitable location where trucks can be returned to the assembly line without interfering with the work on the body or necessitating excessive handling.

e. Actual assembly locations may consist of a few or many positions, depending on the output, personnel, extent of work, etc. The work done at each location must be carefully planned and supervised. The work starts with trimming, drilling, and reaming of the underframe for new reinforcements, parts, or subassemblies; the installation of such parts; the installation of airbrakes equipment; and the work on sides, ends, or roofs. Further work consists of the application of draft gear and couplers and, for a boxcar, the installation of floor and lining. Final operations cover the installation of handbrakes, ladders, and running boards, if required.

f. The completed cars are then moved to the painting area, which also may comprise two or more spot locations, for painting and stenciling. A scale should be provided near the shop for weighing. After the car has been weighed, it is stenciled with the light load weight and is then ready for service.

18-9. Shop Buildings

a. The requirements for service buildings will be dependent on the facilities which are housed in the main shop building and the volume of work to be handled. As noted above, the fabricating and blacksmith shops should be in an area adjacent to the assembly line, also a toolroom, an airbrake room, an electric shop, a pipe shop, offices, a washroom, and a locker room in the main building.

b. The wheel shop, which is a desirable feature of a large shop, will preferably be in a separate building because of outside storage space necessary for wheels, axles, and wheel pairs.

c. Lighting in buildings should be adequate for necessary work when night work is required. Heating should be provided in all enclosed buildings for winter operations. It may also be desirable to provide motor-driven exhaust ventilators to remove fumes and heat from shops, forges, and furnaces.

18-10. Shop Machinery and Equipment

a. The machinery needed in a car repair shop can only be determined after a careful analysis of the machinery and of the characteristics of the work to be performed in the shop. Tables of organization and equipment dictate the equipment authorized for Army railway shop units. In oversea areas, the equipment is augmented by local equipment found in the shops or local area. By securing car sets of prefabricated material, it is possible to rebuild cars on a program basis or to build new cars with very little machinery.

b. The machinery provided for the steel-fabrication and blacksmith shops will have an important bearing on the repair of old cars or the construction of new ones. Special machinery is required for shearing, rolling, bending, forming, and forging the heavy steel plate and parts in modern freight car construction, and it should be used only where the volume of work justifies it.

c. Most freight cars now in service consist of a riveted or welded frame assembly of steel plates, standard rolled sections, and pressed shapes. The older cars of all-riveted construction include many plate assemblies with flanged sections-some with offset bends which originally were formed on giant hydraulic presses. The initial cutting of the plates and rolled-steel sections can be performed with power shears provided with roller tables or supports for easy handling. Oxyacetylene torches, either a hand torch or a straight line cutting machine, may be used.

d. A hydraulic press should be included to form and offset sheets. This equipment also can be used for the manufacture of corrugated car end sheets, hopper doors, and similar flanged parts. A number of power punches of different types will be essential. Single punches will be needed for angles, channels, and plate strips. Gap-type punches with stands and supports will be required for wider shape and plates.

e. Pneumatic and hydraulic forming presses can be shop-built for straightening bent parts, for bending or forming light sections, and for miscellaneous work. One or more furnaces and forges will be essential for heating certain parts before they are reworked and for annealing other items after they have been welded. Blacksmith shop equipment should include steam or power hammers of various sizes, forging machines, furnaces, and forges. Many items such as ladder rungs, platform supports, door hardware, etc., can be reclaimed or manufactured in such a shop.

f. Machine tool equipment for heavy car repair work should comprise a number of radial drills of various lengths, drill presses, bolt threaders, power hacksaws, planers, latches of various sizes, and shapers and grinders at convenient locations. The machine shop tools should also include a lathe, a milling machine, a tool grinder, a drill grinder, and other necessary tools for the manufacture of devices, jigs, and fixtures, as well as for maintenance of equipment. A toolroom is an essential adjunct to a machine shop.

g. Work generally assigned to sheet metal workers in a railroad shop consists of tinning, coppersmithing, and pipefitting. Tinning and coppersmithing consist of building, erecting, assembling, installing, dismantling for repairs, and maintaining parts made of 10-gage sheet metal and lighter and of copper, brass, tin, zinc, white metal, and black planlshed, pickled, and galvanized iron. Brazing, soldering, tinning, and some babbitting are included. The amount of machinery required normally will be limited to a foot-operated shear, a brake, a folder, hand-operated rolls, crimpers, etc. , for lighter gage metal. Sheet metal workers also do welding.

h. Pipework includes bending, fitting, cutting, threading, brazing, connecting, and disconnecting air, water, gas, oil, and steam pipes. The pipe shop section should be equipped with the necessary machinery to form or fabricate any of the standard sizes of pipes used on railway cars. A pipe threading machine with capacity up to 2 1/2-inch pipe will be satisfactory. Hydraulic or power pipe benders are essential.

i. To eliminate handwork or delays, the heavy car repair shop must be provided with a large complement of portable tools for all applicable operations. Tools of this type will include rivet hammers, chipping hammers, drills, reamers, grinders, saws, impact wrenches, portable sanders, and floor sanders. These tools are either pneumatic or electric.

18-11. Materials Handling Equipment

a. The heavy car repair shop will require a full complement of mobile equipment, such as crane trucks, forklift trucks, tractors, trailers, platform trucks, and hand wagons, similar to that listed for light repair operations. Of equal importance is the need for overhead cranes, jib cranes, hoists, monorails, etc. , for handling the multitude of heavy plates, parts, and subassemblies.

b. Cranes should be provided in the repair shop, as well as in material and fabricating bays of the carshop building Capacities will vary from 2: 0 to 5,0 tons over the heavy repair tracks and from 5 to 10 tons for materials handling or truck work. Each crane can serve 2 or 3 tracks from runways extending the full length of the building.

c. Provisions must be made for transfer of material and assemblies from one bay to another by push car or jib cranes. Jib or post type cranes, with electric or pneumatic 1 or 2-ton hoists, are essential for moving plates, parts, and material into and out of machines, presses, furnaces, etc. , and for handling mounted wheels. Monorail hoists are also useful where material is to be moved a relatively short distance from one fixed location to another.

d. Assembly lines located in the open should be provided with monorails, shop-built runways, or pillar-type cranes equipped with 1 or 2-ton hoists to handle plates and subassemblies. A portable gantry crane spanning the entire car will prove useful. Portable pneumatically operated jacks, or possibly fixed power jacks are necessary for jacking cars to remove trucks, bodies, ends, and other heavy assemblies.

e. Skids or pallets should be used in handling both storehouse and shop materials in heavy car repair operations. The skids or pallets can be lifted by platform or forklift trucks and carried from the storehouse to machines or shops and then to the proper location on the repair line, minimizing the costs of shifting and handling material.

f. Gasoline-operated motor vehicles of different types are desirable for handling material, for road trips, and for movement of personnel.

18-12. Material Storage

a. A well designed heavy car repair shop must include storehouse facilities adequate for storing, handling, and distributing the large volume of material required for repair or rebuilding programs. The storehouse building should be of adequate size to stock material items, supplies, and parts which would be affected by exposure. The oil house, whether as part of the main building or separate from it, should have tanks, pumps, and dispensing facilities for packing, oil, grease, solvents, etc. , as required.

b. If sufficient space is available in the carshop building or the fabricating shop, plates, structural-steel shapes, bar iron, etc, can be stored indoors under overhead cranes. Such an arrangement reduces handling costs and delays due to severe cold or rainy weather. Otherwise, hardtop areas should be provided near material car tracks for storage of these items, as well as truck sides, bolsters, fabricated car parts, and other heavy Items not affected by the weather Outside runways with an overhead crane provide an economical means of unloading, storing, and handling material where space is not available inside the shop building. Additional advantages can be secured if these runways are extensions of the shop crane runways.

18-13. Welding and Cutting Operations

a. All-steel freight cars require welding and cutting equipment, some cars feature many welds in their fabrication and assembly; consequently the heavy car repair shop must be equipped for repairs to, or rebuilding of, this type of equipment. The equipment used in the heavy car repair shop includes portable electric welders for manual welding and oxyacetylene cutting, inert gas-shielded metal-arc welding, submerge-d-arc welding, and stud welding equipment.

b. Oxyacetylene cutting torches are indispensable in the stripping operation for burning out or cutting off rivets; removing sections of bent, broken, or corroded sheets, structural shapes, and parts; and cutting scrap to a predetermined size for ease In loading and shipping these torches are also used for welding operations or building up worn spots on cast Iron and malleable iron and for brazing and soldering. The hand-welding torch is most commonly used for this type of work.

c. Portable electric welding sets of the motor generator type, alternating-current transformer type, or rectifier types are used for all hand-welding operations Capacities will range from 150 amperes to 400 amperes for the heavier operations, but most freight car shops have standardized on the rating of 400 amperes for all such work. The repair shop should be well equipped with welding sets so that it is not necessary to haul them from one point to another or to delay repair work while waiting for equipment.

Section III. PASSENGER-TYPE CARS

18-14. General

Making heavy or general repairs (depot maintenance) to passenger car equipment presents problems different from those of freight car repair work since the former normally cannot be performed on a production line basis. The reason for this is that the number of passenger cars is relatively small compared to the number of freight cars and even this comparatively small passenger car population is divided among a wide variety of types. Normally, in times of war, there will be very little passenger car repair work performed, particularly in combat zones. Repairs to passenger train equipment will be feasible in intermediate and rear areas only.

18-15. Shop Buildings and Service Facilities

a. The layout of a passenger car shop depends upon the output capacity of the facilities and personnel, and the type of equipment. Capacity is determined by the general repair policy, the average age of equipment, and the seasonal demands for certain classes of cars. Shopping policy establishes the repair cycle and has a direct bearing on the capacity Military requirements will govern.

b. Each repair track should be served with gas, air, water, and electricity to permit repair work on brake equipment, plumbing, and electrical features while the car is still on the repair track. Small, power-driven tools such as grinders, cutoff saws, and portable drills are required and provision should be made for them. A convenient location for such tools is between repair tracks. In this way, space that is of little use otherwise, although it is necessary for clearance between adjacent cars, is at least partially utilized.

c. Pits are desirable for each repair track so that repairs can be made to the equipment suspended

beneath the car body without raising the car. Improved working conditions where there is a pit will tend to reduce costs and expedite completion of the repairs.

d. Cars should be carefully inspected before they enter the shop to determine what work is necessary, and again after the work has been completed. The inspection facilities should include an inspection pit with test equipment for testing airbrakes, heating, lighting, water supply, and plumbing.

e. The truck shop should be conveniently located near the wheel and axle shop, the blacksmith shop, and the machine shop, and as near the point where the car is unwheeled as conditions will permit. The truck shop may be laid out with tracks upon which the trucks are repaired, or the trucks may rest directly upon the floor. The former method is more conductive to orderly operations

Section IV. WHEEL AND AXLE SHOP

18-16. General

Wheel shop operations should be placed on an efficient basis by the use of the best available machinery and conveying devices. It is essential that careful studies be made and detailed layouts prepared before a new shop is started or an existing one modernized. With proper machinery and equipment capable of or 3-shift operation in a good shop, it is possible to centralize wheel and axle work, thus securing better work, greater production, and appreciable labor economy.

18-17. Wheel Types

a. Narrow flange contour multiple-wear wrought-steel wheels are in general use under passenger cars and passenger equipment in CONUS. One-wear wrought-steel wheels are also used. All kinds of wheels (discussed in detail in paragraphs 4-3 through 4-6) may be found under passenger equipment in oversea areas, so personnel of transportation railway shop units should be familiar with them.

b. Wrought-steel wheels are used for passenger cars and are made in a wide range of designs and in various compositions, untreated and heat-treated. They are classified as multiple-wear and one-wear wheels and are marked MW for multiple-wear and 1W for one-wear on the back of the wheel rim with the year and the manufacturer's brand. Multiple-wear wheels are used for driving wheels of electric and diesel-electric locomotives, and for passenger and freight cars.

c. A one-wear wheel has a minimum rim thickness of 1 1/4 inches, which does not permit restoration of the flange or tread to the original contour after being worn to the condemning limit. These wheels can, however, be reclaimed by turning in conformity with certain rules prescribed in the AAR Wheel Manual.

18-18. Wheel and Limited Defects

a. Wheels and axles are removed from service and sent to the wheel shop for two general reasons: either they are worn to the prescribed limits, or they show a defect that requires removal from service. When a wheel pair (referred to in this section as an axle upon which two wheels are mounted) is removed from a truck for shipment to the wheel shop, a wheel tag or some similar form of marking is used to indicate the reason for removal. Upon arrival at the wheel shop, a further inspection is made to determine whether the condition is such that the wheels are to be dismounted and the journals turned on wheel pairs or the treads turned on steel wheels. While the original basis for removal may have been wheel defects, careful inspection at the wheel shop frequently develops that the axle also is worn beyond limits. The various wheel and axle defects, together with the AAR symbols which are universally used to designate each specific defect, are discussed in paragraphs 43 through 4-8.

b. If the one-wear wheel does not take either a remount or road gage, it does not require turning even though slightly worn. However, if it takes either the remount or road gage, it must be turned before it can be used, provided sufficient metal will remain after the turning operation.

18-19. Wheel Shop Operations

a. Wheels, axles, and bearings when they arrive at the wheel shop, either new or after a period of service, must be rigidly inspected, accurately machined, and properly assembled. They should be restored to operation in such condition that they will render their anticipated term of service without causing train delays as a result of defects or improper workmanship. After

the wheel pairs received at the wheel shop have been Inspected and marked as to disposition, they are sent through the shop in different directions depending upon the nature of the operations to be performed.

b. The following outline shows a typical sequence of operations in a car wheel shop handling all types of wheels.

(1) Wheel pairs are moved from the railroad car to the demounting press.

(2) Wheels are demounted from the axles.

(3) Axles are moved from the demounting press to the axle lathes, axle storage, or scrap axle bin.

(4) Individual wheels are moved from the demounting press to the wheel storage or scrap wheel bin.

(5) Wheel pairs are moved from the railroad car to the wheel grinder, wheel lathe, or Journal-turning lathe.

(6) Individual wheels are moved from storage to the wheel boring mills.

(7) New axles are moved from storage to the axle lathes.

(8) New cast iron or wrought-steel wheels are bored.

(9) Secondhand cast iron or wrought-steel wheels are bored

(10) New or secondhand axles are machined.

(11) Journals on new or secondhand axles are burnished.

(12) Journals on mounted wheel pairs are refinished by turning and burnishing.

(13) Treads on new or secondhand cast iron or wrought-steel wheels are ground.

(14) Treads on wrought-steel wheels are turned.

(15) New or secondhand axles are centered or recentered.

(16) Axles are inspected for defects by the Magnaflux, Magnaglo, X-ray, or Whiting method.

(17) Wheels and axles are matched for mounting. To secure the greatest value from both the wheel seat and the hub bore, it is preferable to mount new wheels on secondhand axles with wheel seats reduced in diameter; and to mount secondhand or worn wheels with increased bore diameter on new axles or those with comparatively large wheel seat diameters. New wheels must never be bored for application to oversize wheel seats. The wheel bore should always be fitted to the axle, not the axle to the wheel bore. See figure 419 for example of selection of wheels and axles for mounting.

(18) Wheels and axles are moved from the boring mills and the axle lathes to the mounting press. See figure 18-1 for AAR-approved mounting pressures.

(19) Mounted wheels are given their final shop inspection before storage or shipment.

(20) A protective coating is applied to axle journals.

(21) Finished wheel pairs are moved to storage or are loaded on cars for shipment.

c. Figure 18-2 shows the actual distribution or flow of 100 wheel pairs and the course through the shop taken by the parts necessary to complete them, including the assembly of the necessary finished parts, both new and from storage. The quantities may vary considerably from one shop to another, depending upon the number of cast iron or steel wheel pairs received, whether the wheel pairs are ground, treads turned, or journals turned; and whether diesel wheelwork is included in the shop operations. This chart shows the sequence of operations on wheels, axles, and wheel pairs.

18-20. Handling Wheel Pairs

a. It is the usual practice to transport wheel pairs in special cars designed and regularly assigned for wheel service, although gondolas may be used. A standard flatcar or gondola will accommodate

WHEEL PRESS PRACTICE

Class of Axle	Journal Size	Nominal Wheel Seat Diameter	Cast Iron Wheels Min	Cast Iron Wheels Max	Steel Wheels Min	Steel Wheels Max
A	3 3/4" x 7"	5 1/8"	30	55	50	70
		5 1/2"	35	60	55	80
B	4 1/4" x 8"	5 3/4"				
		6 5/16"	40	65	70	100
C	5" x 9"	6 1/2"				
		7"	45	70	75	110
D	5 1/2" x 10"	7"				
		7 9/16"	50	75	80	120
E	6" x 11"	7 518"				
		8 1/4"	55	80	85	130
F	6 1/2" x 12"	8 1/8"				
		8 3/4"			90	140

*Nominal Wheel Seat Diameters of A A R Axles
No tolerances permitted below minimum or above maximum pressures shown above

Figure 18-1. Wheel mounting pressures, in tons.

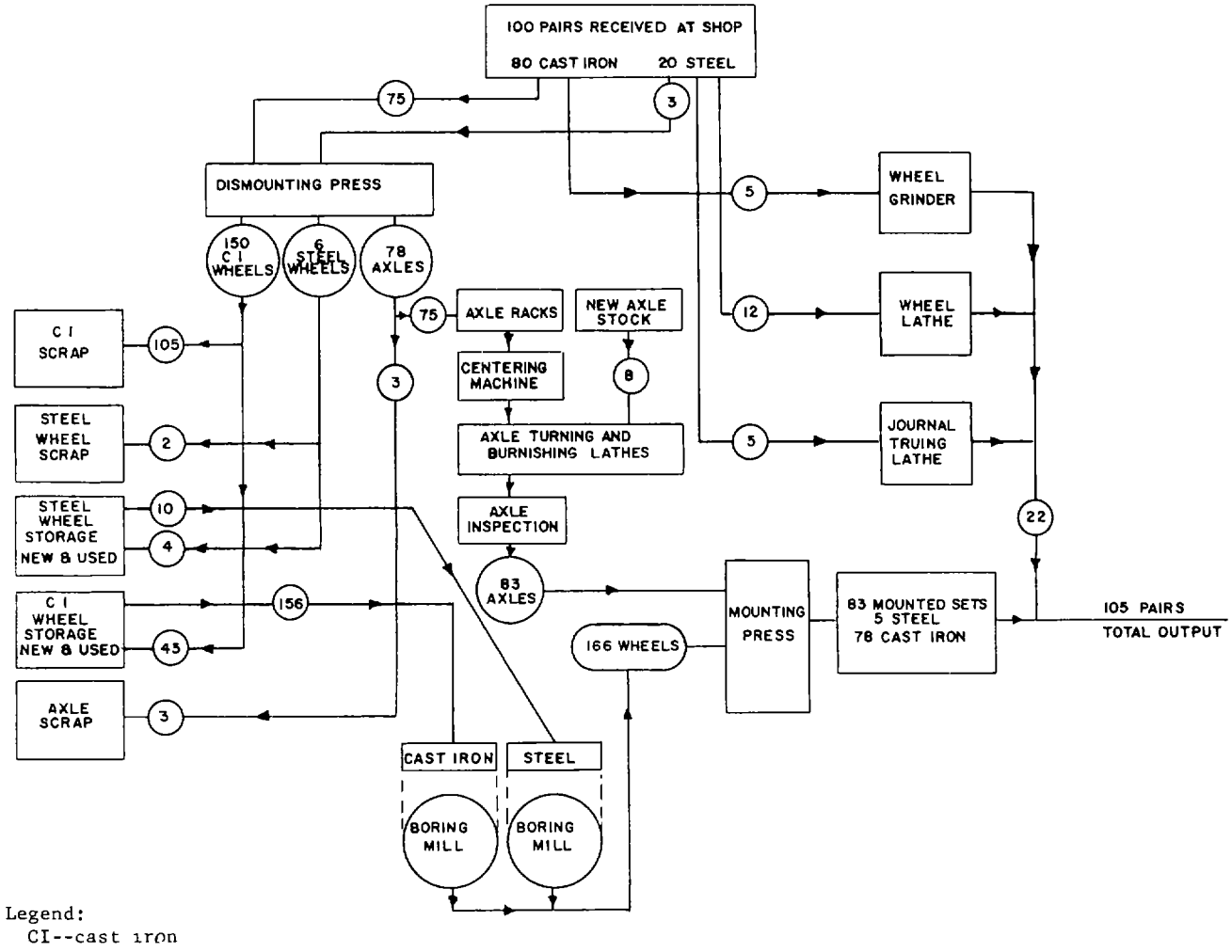


Figure 18-2. Work flow chart showing course of axles and wheels through the shop.

approximately 20 wheel pairs in a single layer. A car arriving at a wheel shop may contain a variety of wheels of different journal sizes and types. Some may be cast iron or wrought-steel to be dismounted; others may require that one or both journals be turned; or wrought-steel multiple or one-wear wheels may require their treads to be turned. Wheels should be tagged or plainly marked to show the defect. Wheels requiring similar work should be placed together.

b. Wheels storage tracks must be spaced so that the flanges of one pair of wheels cannot strike either the journal or the center portion of the axle of an adjacent pair. A nick in the journal may cause a hotbox, and a nick in the center portion of an axle may lead to breakage. Spacing pairs of rails 6 inches on center will prevent (nicking as the flanges will then strike the hub of the next wheel. To prevent axles and flanges from contacting wheels of different nominal diameters, wheels should be segregated so that those widely varying diameters are not stored together. For example, 33-inch nominal diameter wheels should not be stored with 36-inch nominal wheels. Multiple-wear wheels of the same nominal diameter should be further segregated so that those having a rim thickness 1 3/4 inches or more are stored separately from those having a rim thickness of less than 1 3/4 inches.

c. Dolly cars, turntables, hoists, or cranes can be used to move wheel pairs from the storage tracks to the car wheel lathe or the journal-turning lathe. Wheel pairs for demounting should be rolled directly from storage tracks into the wheel press or should be handled automatically to eliminate the labor which would normally be required.

18-21. Handling Axles

a. New axles can be unloaded from cars to storage racks by a locomotive crane, a mobile crane truck, forklift trucks, or a hoist, depending on the type of car and the method of loading.

New axle storage racks should be designed with separate tiers for each size and type of axle and should be arranged to feed the axles into the shop as required.

b. Scrap axles from the demounting press should be conveyed to a location where they can be loaded into cars for shipment to the scrap dock. After axles have been turned, they are moved to the burnishing lathe, then to the inspection station, and finally to the mounting press. The handling of axles In and out of lathes is done by a suitable crane or hoist. Still another satisfactory arrangement is the use of an overhead monorail and a 1 or 2-ton electric hoist to lift axles as they come out of the demount press and to carry them to scrap-axle storage racks, to secondhand axle storage racks, or to the axle lathes.

c. Means should be provided for cleaning all secondhand axles before they start through the shop. Removal of dirt and scale from the body of the axle and of oil or protective coatings from journals will insure more positive Magnaflux or Magnaglo tests regardless of whether the dry or wet method is used Cleaning is particularly important with Magnaglo tests, since dust, dirt, and oil will contaminate the oil bath medium and seriously affect the quality of the test Any cleaning method, such as handcleaning, placing the axle in a lye vat, sandblasting or gritblasting the body of the axle, flame cleaning with oxyacetylene, or wire-brush cleaning is satisfactory.

18-22. Handling Loose Wheels

a. Loose wheels may be received in gondolas, boxcars, or special wheel cars which provide racks land blocking to hold the wheels in an upright position. They can be unloaded by mobile crane truck or by a forklift truck, or they can be rolled manually. The forklift truck offers the most convenient method, since the wheels are always held upright. New wheels, after being unloaded from cars, are stocked upright in rows outside the building and segregated as to kind and tape sizes. The simplest method for moving the wheels from storage is by hand-rolling, but this involves an excessive amount of labor and the possibility of personal injury.

b. In a large shop, an arrangement can be provided using two dollies to hold the wheel upright until the axle is removed. The wheel pairs roll out of the remounting press into this arrangement, an overhead hoist lifts the axle slightly, and the dollies move away from the axle carrying wheels with them in an upright position.

c. Wheels which have been dismounted but which can be reused can be handled from the demount press to storage or to the boring mill by forklift truck, roller wheel conveyor, monorail, or overhead crane, or they may be hand-rolled. Wheels of this type will be relatively few, mainly wrought-steel wheels removed because of a defective axle.

18-23. Demounting Wheels From Axles

a. The most efficient and satisfactory arrangement for demounting is the use of a high-speed hydraulic double-cylinder demount press. A wheel pair is rolled into the press and the ram pushes one end of the axle as the near wheel is held by the center beam. One man rolls the wheel pair out, and another takes the loose wheel and rolls it to the disposal chute. The first man turns the axle and one wheel assembly and rolls it back into the press As soon as the second wheel has been pressed off, one man removes the loose wheel and the other picks up the axle with a hoist and places it on a rack b When wheels are demounted, they should be rebored. The same care in tolerance and finish should be observed as with new wheels Care must be taken to secure the greatest value from the metal In both wheel seat and hub through economical selection of wheels and axles (para 18-25).

18-24. Wheel Press Practice

a. Separate presses should be used for mounting and demounting wheels, where possible, to increase production. If the same press is used for both operations, it should have a capacity of 400 to 600 tons. Mounting pressures are shown in figure 18-1.

b. Wheel mounting presses must be provided with a dial pressure gage and a pressure recording gage. These gages must agree with each other, and the dial gage must be checked at least every 6 months with a deadweight tester or an accurate master gage. The gages must always be used for every mounting operation. The recording gage must make a complete wheel fit pressure diagram of the type in figure 18-3 for each wheel mounted. The diagram for the mounting of each wheel should be marked to show the type of wheel, its make, identifying number, and axle size. Wheel mounting and check gages must be checked frequently by the shop foreman or the test department so that excessive gage wear will not cause improper mounting.

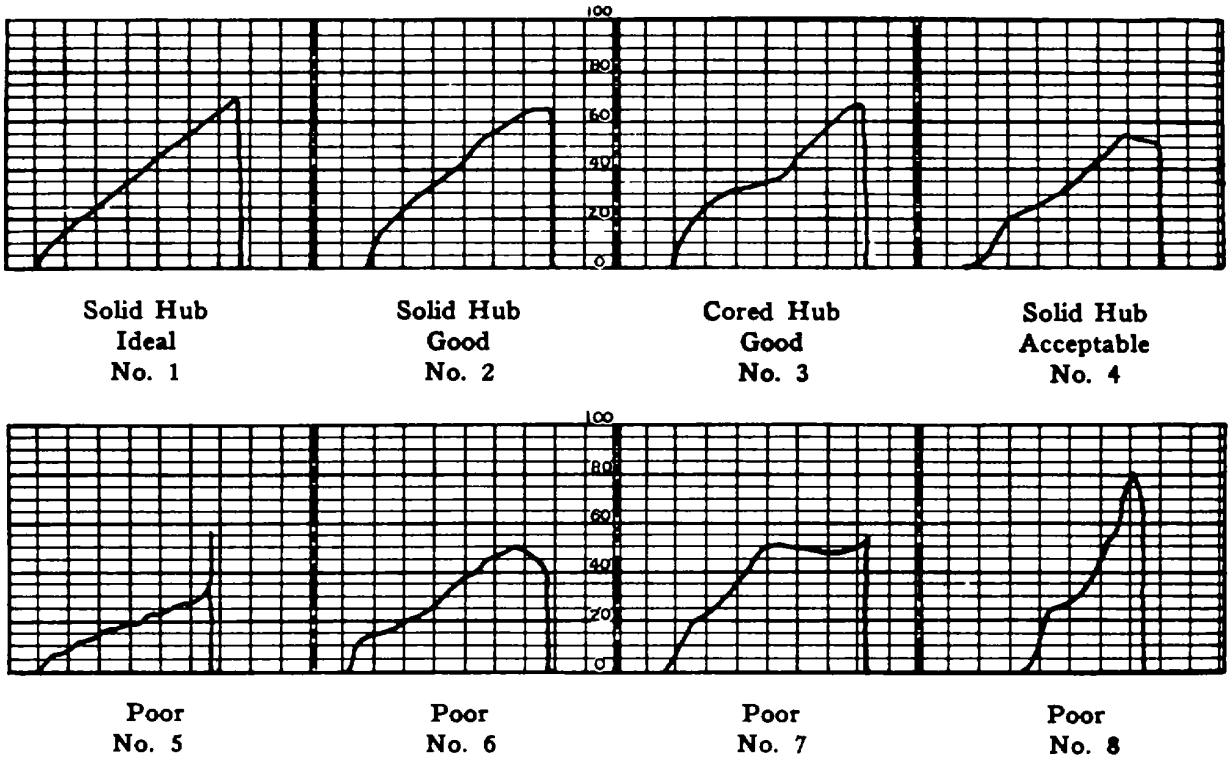


Figure 18-4. Wheel-fit pressure diagram.

c. During mounting, the pressure gage must be watched and, if pressure is outside the limits given in figure 18-1, diagrams showing such misfits must be plainly marked "misfit." Misfit mountings must be corrected. The limits given in figure 18-1 apply to wheel fits of the multigage fleet of Department of Army cars. In mounting the wheels, both Journals must be protected with efficient guards during the entire operation to prevent nicking and scratching the surfaces of the journal.

d. Immediately before the wheels are placed on the axle, the wheel seats and the bore of the wheels must be carefully cleaned and coated with a mixture of basic carbonate white lead and boiled linseed oil in a proportion of 12 pounds of white lead paste to 1 gallon of boiled linseed oil, thoroughly mixed. A fresh supply should be mixed every few days. If desired, ready-mixed white lead compound may be purchased in gallon containers of approximately 14 pounds each Its specifications must comply with regulations. Wheels are placed on the ends of the axle, the assembly rolled into the press, and the axle pressed into the bore of the wheel. Then the axle and wheels are reversed and rolled back into the press and the process is repeated for ,the other wheel. It is essential that a final inspection of all wheel pairs be made before they are placed on storage tracks or are loaded for shipment.

e. Wheels must be mounted centrally with respect to the center of the axle. A suitable axle center gage similar to those shown in AAR Wheel and Axle Manual and the mounting gages shown in figures 4-18 and 4-19 should be used. If rims and flanges do not run in a plane at right angles to the axis of the axle, the wheels will take the mounting gage at only 1 or 2 of 3 equidistant points on the circumference of the wheels. The journals and wheel treads must be checked and, if out, must be turned to within prescribed tolerances. Wheels that will not take the mounting gage at any of the three points must be demounted and checked for diagonal bore and the axle checked to see whether it is bent. If the axle is bent and shows a runout of more than 1/4-inch at the center, it should be straightened, if possible. Flat spots and other forging irregularities should be compensated for in measuring 1/4-inch runout. Axles which cannot be straightened must be scrapped.

f. New wheels mounted on the same axle must be of the same tape size and bear the same tape size marking. Secondhand wheels should be as

nearly the same diameter as possible and must not vary more than half tape size when measured with a standard wheel tape. In selecting wheels for mating, in machining wheels and axles, and In mounting them for interchange service, the following points must be observed:

(1) New wheels must not be mated with secondhand wheels.

(2) One-wear wrought-steel wheels must not be mated with multiple-wear wrought-steel wheels.

(3) Double-plate cast iron wheels and wheels and single-plate nonbracketed-design cast iron wheels must not be mated.

(4) Cast iron wheels varying over 25 pounds in marked weight must not be mounted on the same axle.

(5) Cast iron single-plate nonbracketed wheels must not be mated with iron single-plate bracketed wheels.

(6) Heat will not be applied to the hub of a tight wheel with a torch to assist in disloading it. Wheels bearing any evidence of such heating or which have holes burned in the plate by a torch must be scrapped.

g. In handling pairs of mounted wheels, wheel sticks must not be used on the journal surface. Journals of mounted axles must be coated with rust preventive, unless they are to be placed directly in the trucks. Before placing wheels with coated journals in a truck, the coating must be carefully removed with a suitable solvent (para 18-33).

18-25. Boring-Mill Practice

a. Boring mills must be maintained with the table running true and with the boring bar held true with respect to the center and the plane of the table, and must not chatter.

b. Chuck jaws must be properly alined radially and vertically. Contour of the chuck jaw may have a taper of 1 inch in 20 inches to correspond to the wheel tread line or it may be maintained vertically The boring bar must have a position micrometer adjustment for the cutters accurate to 0. 001 inch.

c. If roughing and finishing cutters are carried on the boring bar at the same time, they must be separated by a distance greater than the length of the hub, unless the roughing and finishing cuts are separate operations With the wheel properly alined in position on the mill with regard to concentricity and to plane, the metal must be removed from the bore of new wheels by 2 or more separate cuts; that is, 1 or more roughing cuts and 1 finishing cut. A radius or chamfer of approximately 1/8 of an inch must be turned at the entry or back end of the hub after the finishing cut The finished wheel bore must be within the limits for rotundity and taper and must be smooth and concentric with the tread.

d. Inside and outside micrometer calipers are necessary for the measurement of wheel bores and axles wheel seats to insure consistent results. On each wheel bore and axle wheel seat, a fine, smooth machine finish is required and must be checked at not less than three points in its length, and on two different diameters, at each of these points, to insure rotundity and absence of taper. The variation for any two of these measurements must not exceed 0 002 inch. The bore should be smaller than the wheel seat diameter, with a tolerance of 0. 0. 01 inch per inch of diameter of wheel seat for wrought-steel wheels. For cast iron wheels, the tolerance should be equivalent to 0.005 inch per inch of wheel seat diameter and a maximum of 0.102 inch.

e. Permissible variations in dimensions for cast steel wheels not shown by tolerances on individual design sheets are indicated below Figures 18-4 and 18-5 show dimensions for machining 33-inch one-wear and multiple-wear wheels

(1) *Inside diameter-back face of rim*. The inside diameter of the rim at the back face of the wheel shall not vary more than 3/8 inch under the nominal dimension. The maximum diameter at this location is governed by the rim thickness and the tape size.

(2) *Inside diameter-front face of rim*. For narrow flange wheels, the inside diameter of the rim at the front face of the wheel shall not exceed that at the back face of the wheel and shall not vary under this dimension by more than 1/4 inch. For wide flange wheels, the inside diameter of the rim at the front face of the wheel shall not differ from that at the back face of the wheel by more than 1/4 inch.

(3) *Thickness of rim*. In any wheel, the radial thickness of the rim shall not vary more than 1/8 inch around the wheel.

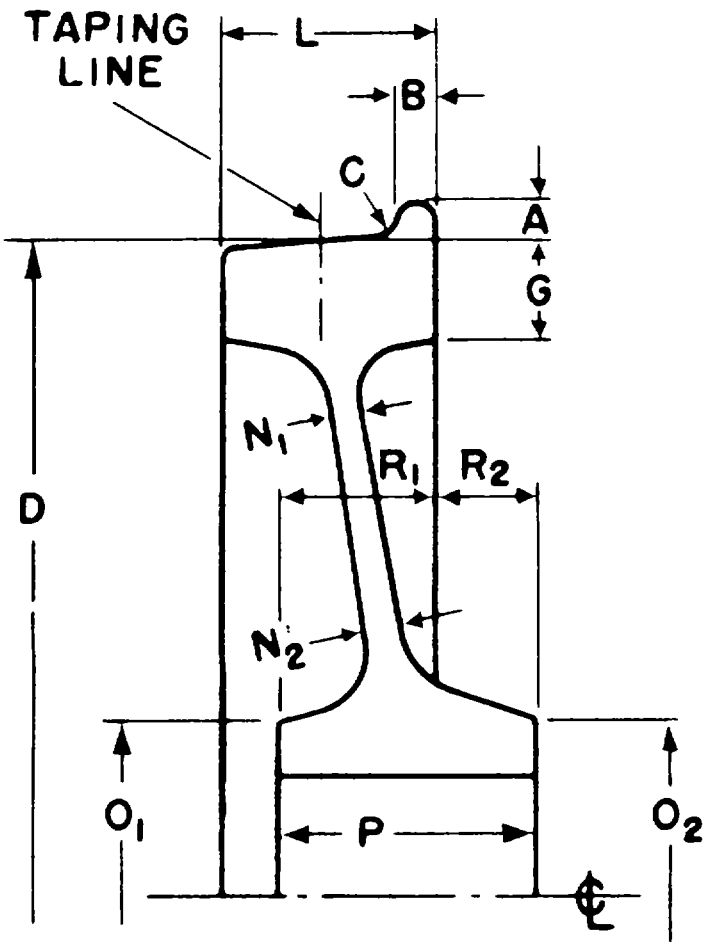
(4) *Corner at inside diameter of back face*. A sharp corner is preferable to facilitate measurement. In any case, the radius of the corner shall not exceed 1/8 inch.

(5) *Plane of back face*. When wheels are gaged with a straightedge applied to back face of rim, no point on back face of narrow flange wheels more than 1 1/4 inch from inside edge of rim shall be more than 1/32 inch from the

CA-33, Steel Freight Car Wheels

Standard
CA-33 adopted 1956, revised 1960, 1962

The wheel cross section diagram is provided to show location of tabulated dimensions only.



33" one wear cast steel freight car wheel with 1⅜" thick flange ⅝" above base line.

A A R DESIGN	CA-33
TYPE TREAD	1-W
INTENDED MAX AXLE	5 1/2 x 10 STD.
INTENDED CAR CAPACITY	40 AND 50 TON

DIMENSIONS & TOLERANCES

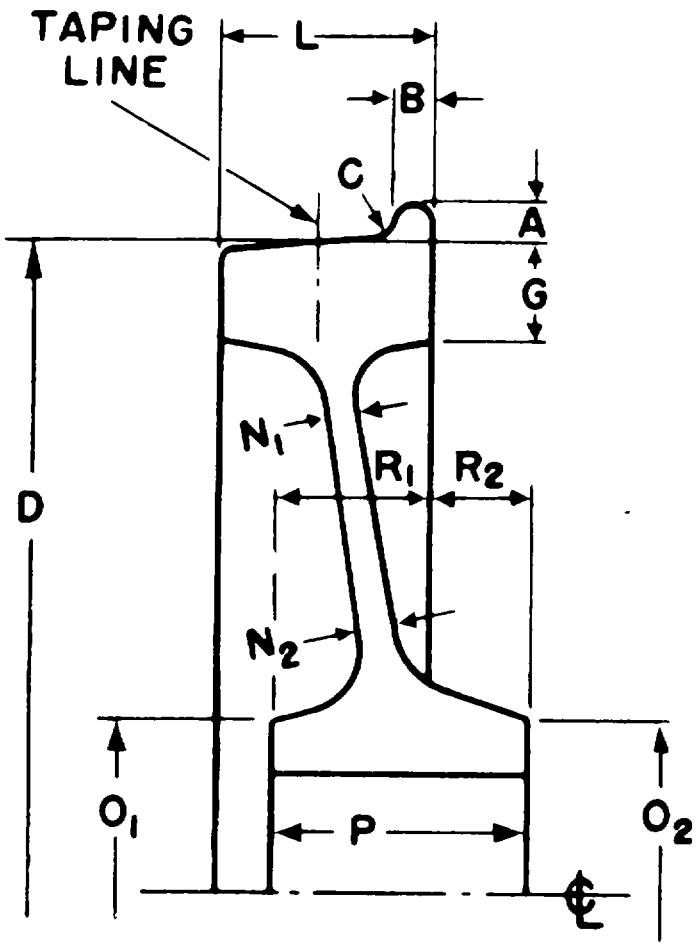
A	$1^{+\ 1/16}_{-\ 0}$
B	$1\frac{3}{8}\ ^{+\ 1/32}_{-\ 3/32}$
C	$\frac{3}{4} \pm 1/16$
D	33 + 14 TAPES (5% − 5)
G	$1\frac{1}{4}$ MIN (5%−1/8)
L	$5\frac{23}{32} \pm 1/8$
N_1	$\frac{3}{4}$ MIN.
N_2	$\frac{3}{4}$ MIN
O_1	$9\frac{1}{8}\ ^{+\ 1\text{-}3/8}_{-\ 0}$
O_2	$9\frac{1}{8}\ ^{+\ 1}_{-\ 0}$
P	$7 \pm 1/4$
R_1	$4\frac{1}{2}\ ^{+\ 0}_{-\ 1/4}$
R_2	$2\frac{1}{2} \pm 1/4$
MAX FINISH BORE	$7\frac{1}{8}$
MIN HUB WALL	1

Figure 18-4. Thirty-three-inch one-wear cast steel freight car wheel.

CN-33, Steel Freight Car Wheels

Standard
Adopted, 1962

The wheel cross section diagram is provided to show location of tabulated dimensions only



A A R. DESIGN	CN-33
TYPE TREAD	M-W
INTENDED MAX AXLE	5 1/2 x 10 STD
INTENDED CAR CAPACITY	40 AND 50 TON

DIMENSIONS & TOLERANCES

A	$1^{+\ 1/16}_{-\ 0}$
B	$1\frac{3}{8}\ ^{+\ 1/32}_{-\ 3/32}$
C	$\frac{3}{4} \pm 1/16$
D	33 + 14 TAPES (5%–5)
G	$2\frac{1}{2}$ MIN (5%–1/8)
L	$5\frac{23}{32} \pm 1/8$
N_1	$\frac{3}{4}$ MIN
N_2	$\frac{3}{4}$ MIN
O_1	$9\frac{1}{8}\ ^{+\ 1\text{-}3/8}_{-\ 0}$
O_2	$9\frac{1}{8}\ ^{+\ 1}_{-\ 0}$
P	$7 \pm 1/4$
R_1	$4\frac{1}{2}\ ^{+\ 0}_{-\ 1/4}$
R_2	$2\frac{1}{2} \pm 1/4$
MAX FINISH BORE	$7\frac{1}{8}$
MIN. HUB WALL	1

Figure 18-5. Thirty-three-inch multiple-wear (MW) cast steel freight car wheel.

straightedge. For wide flange wheels, no point on back face of rim shall be more than 1/16 inch from straightedge.

(6) *Hub wall thickness*. The thickness of the hubwall in any one wheel measured at any two points equidistant from the face of the hub shall not vary by more than 3/8 inch if the hub is not machined, nor by more than 1/8 inch if the hub is machined. Hub length tolerance is based on finished dimension.

(7) *Rotundity*. Tread when gaged with a ring gage must not have opening between tread and gage at any point over 1/32 inch.

(8) *Diameter of bore*. The diameter of rough bore shall not vary more than 1/16 inch over, nor more than 1/8 inch under the dimensions specified. The specified rough bore shall be at least 1/4 inch less in diameter than the finished bore, subject to 1/16-inch tolerance and/or 1/8 inch under the diameter specified.

(9) *Eccentricity bore*. Eccentricity between the rough bore and tread measured in the plane of the taping line shall not exceed 1/8 inch.

18-26. Machining Axles

a. The modern design of the center-drive axle lathe features antifriction bearings in the head- stock, tallstock, and driver chuck. This lathe is capable of high-speed operation using carbide tools. An average production of 10 to 12 axles in 8 hours is possible on this type of machine.

b. Greater production can be secured from end-drive axle lathes if available. One design uses separate drive motors on the headstocks and tailstocks, two carriages with a swivel toolholder and, if desired, an opposed equalizing burnishing attachment on each carriage. Since axles are turned and burnished on one machine and may be rolled into and out of the machine, machining time is greatly reduced This machine operated by one man has a production rate as high as 18 axles in 8 hours.

c. Machining diesel locomotive or streamlined passenger car axles from rough-turned blanks re- quires more care than machining freight car axles which normally do not require turning the body of the axle between the wheel seats. The severity of the service required of these axles necessitates particular attention to the surface condition of all highly stressed steel parts, and good shop practice is to grind the axles all over after they have been machined.

d. The journals of freight car axles must be rolled or burnished to a fine, smooth finish after machining. Burnishing lathes have antifriction bearings throughout; an end-drive arrangement; and two carriages, each holding two opposed rollers with equalizing screws. Rollers can be fed by handwheel or by hydraulic cylinders which permit greater pressures. The average output on a machine of this type is 48 axles on an 8-hour shift.

18-27. Refinishing Journals on Wheel Pairs

a. Defective journals on wheel pairs are regularly turned on axle lathes similar to those previously described except for modifications to accommodate and swing the wheel pair. Center- drive journal lathes (fig 18-6) are modified by providing deep gaps in the bed for the wheels and a hinged, split center-drive arrangement which can be opened to admit the axle. The carriages are equipped with either single or opposed burnishing rolls. The average output of a machine of this type using carbide tools is 16 pairs in 8 hours.

b. The end-drive axle lathe is furnished with both headstock and tallstock raised to swing 49 inches over the bed The two carriages are arranged for swivel type toolholders, carbide tooling, and opposed burnishing rolls. Owing to the lathe's design, a simple, shop-built loading arrangement is possible. Production with 1 man operating the machine will be 20 to 25 wheel pairs in 8 hours.

18-28. Wheel Lathe ,Practice

a. General

(1) When a pair of standard one-wear, multiple-wear wrought-steel, or multiple-wear cast-steel wheels is removed from service because of a normal service defeat, the wheels may be placed in a lathe and machined to a new tread and flange contour with minor expense and little loss of time. This process is then repeated as occasion demands until the rim is finally reduced to the scrapping limit of 3/4-inch thickness for freight cars and 1-inch thickness for passenger cars.

(2) A minimum number of 33-inch nominal diameter cast steel and wrought-steel wheels and 36-inch nominal diameter wrought-steel wheels of various hub diameters should be held in stock. Either 33-inch or 36-inch nominal diameter wrought-steel wheels which have been condemned at 1-inch rim thickness for use under passenger cars may be reapplied under freight cars for an additional service period before they reach the final 3/4-inch rim thickness condemning

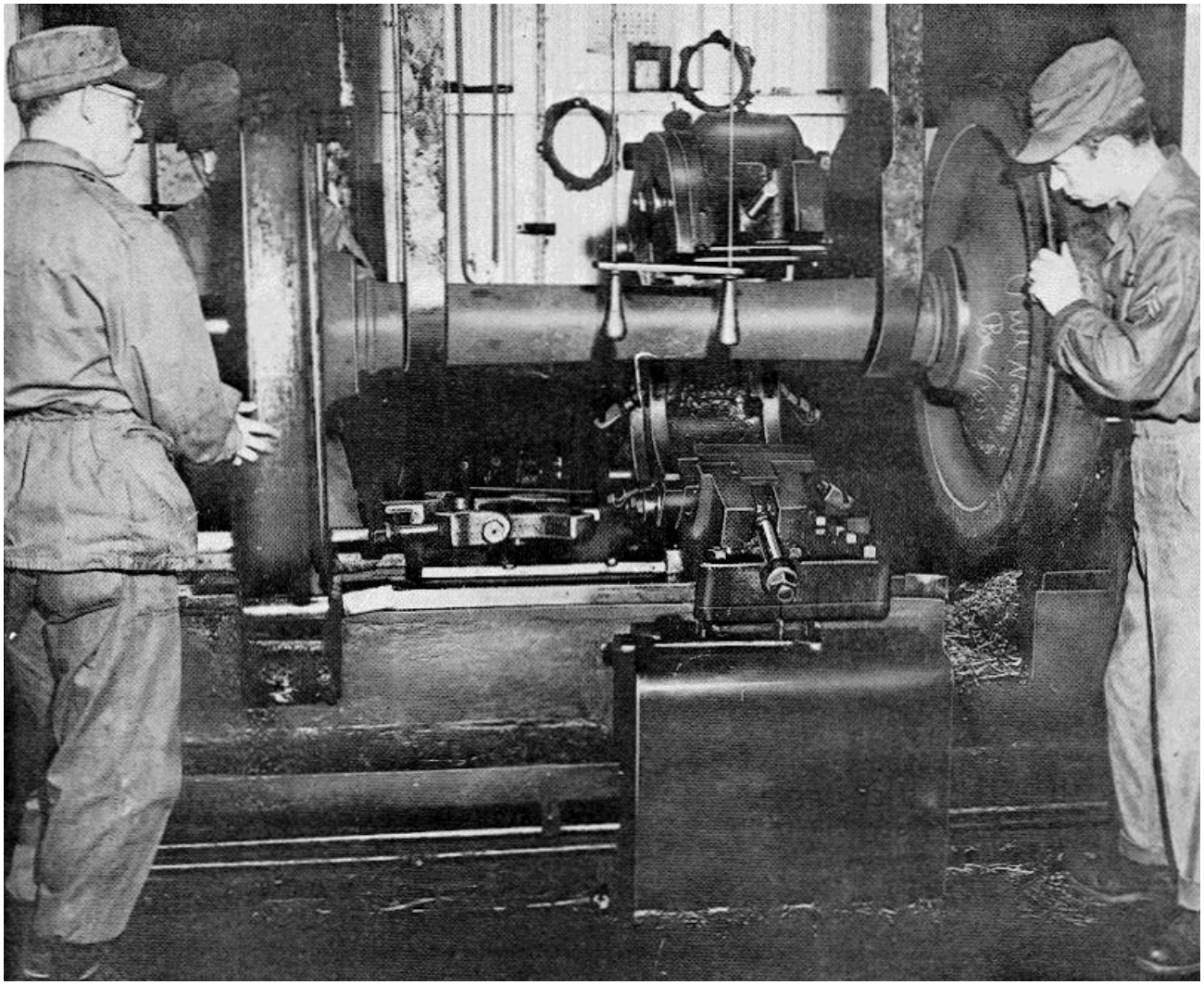


Figure 18-6. Typical center-drive journal lathe.

limit. Wheel shop foremen, inspectors, and wheel-lathe operators should be thoroughly familiar with wrought-steel wheel defects.

(3) Normally, the turning of wheels is performed to correct ordinary service defects, such as thin flanges, vertical flanges, high flanges, and slid-flat spots. The tread should be machined to a smooth finish. If a wheel is turned and released for service after too rough a cut, it will be worn away rapidly by the rail and brakeshoe. Moreover, brakeshoes may grab, causing slid-flat spots, which in turn result In thermal checking.

b. Lathe and Tools

(1) To get a good head surface, a sturdy lathe with ample power is necessary. A lathe operator should not have to force his machine in order to turn out the requisite number of wheels. If he does, the finished surface will have chatter marks or the fish scale appearance, which indicates poor workmanship.

(2) The tools necessary to complete the operation of restoring the tread and flange contour are a roundnose roughing tool or round-button tool, which is used to cut the top off the flange and to rough off the tread to within about 3/32 of an Inch of the finished tread surface, and three finishing tools The finishing tools are forming blades and act as scrapers rather than as ordinary cutting tools. All the tools are held in a turret type of sliding toolpost, so that it is not necessary to change tools during the operation.

18-29. Steel-Wheel Gage

a. Before a pair of wheels is put in the lathe, each wheel should be taped and gaged with a steel-wheel gage at the point where the flange and rim are thinnest. The gage should be applied to at least three points around the circumference and at least a quarter circle apart. The tape size, the rim thickness, and the amount to be turned off the tread to restore the contour as read from the gage should be chalked on the backplate of each wheel. On some wrought-steel wheels, especially those that have been in service a long time, the inside edge of the rim is not clearly defined because the surface is rounded at the point where the scale on the long leg of the wheel gage should intersect the line of the inside surface of the rim. Where such a condition is encountered, a straightedge may be applied to the inside surface of the rim to protect the line of this surface over to the scale on the edge of the gage, and the gage reading may be obtained at the point where the straightedge intersects the scale.

b. The steel-wheel gage is so calibrated that, when applied as shown in figure 4-26 with the leg flat against the back of the rim and the end of the movable finger pressed against the face of the flange, the scale on the finger will show in sixteenths of an inch the amount of metal to be removed at the center of the tread in order to restore the flange contour to the witness groove. The 0 mark on the finger corresponds to a normal flange thickness of 1 5/32 inches, 5/8 inch above the baseline. The specification tolerance permits this dimension to vary 1/16 of an inch over but may never be less.

c. The witness groove in the flange serves two purposes. First, its presence in the finished turned wheel shows that the lathe operator has not wasted service metal by turning more off the tread than necessary Second, if the wheel has a thin or vertical flange, the witness groove saves 1/8 inch of service metal each time a wheel is turned. However, the witness groove must not be more than 3/64 of an Inch deep (fig. 18-7) and must not extend into the throat of the flange. Owing to the important part the throat plays in wheel service and safety, it is essential that these limits for the witness groove be observed.

18-30. Centering or Recentering Axles

Wheel shops should clean out the centers on secondhand axles, using a grinder to remove any burrs or rolled-over edges. Heavy-duty stationary

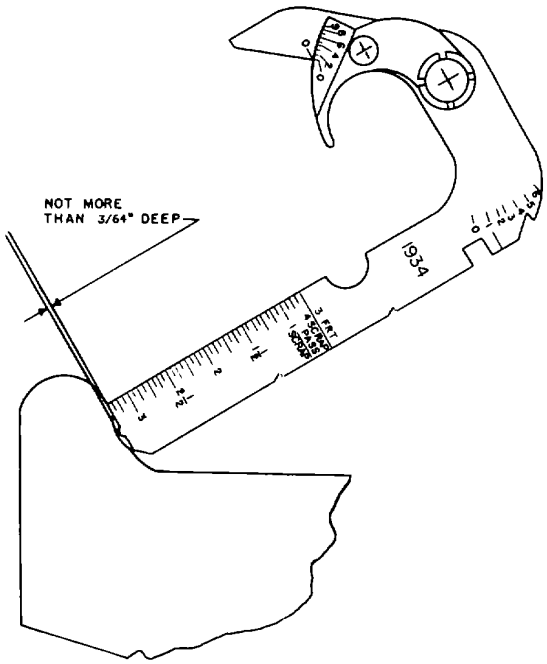


Figure 18-7. Method of applying steel-wheel gage to check depth of witness groove in flange.

machines are used for this purpose. In general, they include mechanically or hydraulically operated clamping blocks which grip either the wheel seat or the journal. The headstock and tailstock have individual motors, each driving a tapered reamer or cutter which is centered with the clamping blocks The design is such that the axle can be rolled in and clamped by the blocks, and the reamers can be fed into the ends of the axle automatically until they reach an adjustable stop.

18-31. Axle-Lathe Practice

a. Axle lathes must be maintained so that lathe centers are In alinement and the wear between the ways and the tool carriages must be taken up so machining of axles is truly concentric and without taper or chatter. Spindle bearings must be renewed when necessary to insure accurate turning. Lathe centers must be reground or renewed when they show signs of wear.

b. The lathe tools used for finishing cuts on collars, journals, and wheel seats should have an edge approximately 1 1/4 inches wide and be absolutely straight except for a 1/8-inch radius at one side for cutting the back or dust-guard fillet, or some other tool arrangement must be used that will give equivalent results. Separate tools must be used for the roughing

and finishing cuts Sharp-nosed tools and coarse horizontal feeds must not be used to finish wheel seat surfaces.

c. Wheel seats must not be polished or filed. A smooth machine cut gives the best results. Outside micrometer calipers must be used for measuring axle wheel seats.

d. A taper of 1/32-inch diameter extending a maximum of 1/2-inch from the dust-guard seat must be turned in the wheel seat to insure entry into the wheel and to prevent tearing and gouging during mounting. Depressions, continuous streaks, or injuries to the surface of the metal of the wheel seat or journals must be removed by a machine cut in a lathe.

e. Centering holes in the ends of axles must taper at an angle of 60°. To insure concentricity when turning, center holes must be wiped clean before the axles are placed in the lathe. Any burrs formed around centers by turning must be removed.

f. Files should not be used on journal surfaces or fillets, but they may be used to break the sharp edges of the end collars and the dust guard seat Journals must never be ground with a coarse abrasive, but they may be smoothed with No. 180 grit or finer abrasive cloth under light pressure.

g. Journals should be rolled to a finish with a hardened steel roller which preferably has a face 1 1/4 inches wide and edges which are turned to a 1/8-inch radius for the collar end and a radius at the other end to suit the journal fillet. The roller should be mounted with a hardened pin and bushing or by roller or ball bearings in a shank to fit the toolpost.

h. While journals are being rolled, they must be coated with suitable oil Satisfactory mixtures are 1 or 2 parts of lard oil and 1 part of lard oil to 3 parts of red machine oil. Before journal surface is rolled, it must be clean and free from metal chips.

i. Journal fillets and end collars must be machined smooth before they are rolled. Dust guard seats should be finished smooth and may be rolled. The end collar must be smooth to avoid disturbing the packing. The horizontal surfaces, when the journal diameter has been reduced 1/4 inch or more, must be turned and rolled to maintain the same difference in diameter between the journal and the collar as when new.

j. Before use, all unmounted axles must be checked in the lathe or between centers for rotundity, concentricity, and absence of taper of wheel seats and journals. Where out of tolerance, correction must be made.

k. Wheel seats of secondhand axles must be returned before being remounted All second-hand axles should be magnetic-particle tested before they are remounted. If the journal surface or end of the axle has any discoloration due to overheating (a light-straw or dark-straw color or any departure from the normal bright finish of the journal) or if circumferential checks or cracks are found in the journals, wheel seats, or body of the axle, the axle must be scrapped unless the discoloration, checks, or cracks can be turned out without going below the condemning limits.

18-32. Matching Wheels and Axles for Mounting

Current practice is the use of step sizes in turning wheel-fit diameters in the axle lathes. The steps are in increments of 1/32 of an inch, with the minimum diameter the shop limit for each particular size of axle. The step sizes can be numbered from 1 to 13. Size No. 1 is the minimum or shop limit, No. 9 the standard, and Nos. 10 to 13 oversizes. The wheels are bored to match the axles, and a lineup of the axles and size numbers is listed on a chart for the guidance of each boring-mill operator. This method of operation requires that only one nominal size of axle be handled each working day.

18-33. Protective Coating on Journals

The journals of all axles on wheel pairs must be coated with a rust preventive which will not wash away but which may be wiped off easily. The journals of unmounted axles, if placed in storage, should likewise be protected by a suitable coating. It is essential that the coating be applied as soon as possible after the journal has been burnished, since rusting may start within an hour or so. There are various rust preventives on the market which are suitable for this purpose, or a mixture of paint and oil may be used. The normal method of application is with a brush. The entire surface from the wheel hub to the end of the axle must be covered.

Section V. PAINT SHOP, RAILWAY CARS

18-34. General

Although freight cars may be painted in the open, it is generally considered advisable to paint them in a shop Passenger cars should be painted in a shop or closed building. Cars can be painted more quickly In a shop, and weather conditions do not interfere; moreover, the results are better. Freight cars normally are prepared for painting outside the paint shop, and protection from the weather is not always necessary. The size of a paint shop for freight cars may be determined by the number of cars in service, their general condition, and the number of cars to be painted annually, the length of time in the shop depending upon the amount of cleaning done inside the shop, the number of coats of paint applied, and the stenciling. Painting is discussed in chapters 13 and 14.

18-35. Car Paint Shop Facilities

a. The paint shop should be constructed entirely of fireproof material and have a concrete floor with a smooth surface and good drainage. The floor should be waterproof, and its corners should be rounded to facilitate cleaning. All shelves and lockers should be of noncombustible material. Any source of sparking, such as electric wiring, switches, or belt-driven equipment, which would produce electric arcing or static electricity, should be eliminated or installed in such a way that paint fumes cannot Ignite. A paint shop should be provided with an automatic sprinkle system and fire extinguishers in accordance with fire prevention laws and recommendations. Where possible, the paint should be stored in a separate building (para 13-2d(7)).

b. The same type of sandblasting shed may be used for both freight and passenger cars. It should be made long enough to take two cars at a time when the number of cars to be handled so requires, and if possible, should be served by the transfer table. Such location will avoid the annoyance of the dust in the other shops and will save delays incident to switching movements (para 13-2e).

18-36. Scaffolding

a. Scaffolds may be of the elevator type and may extend the length of the enclosure. There should be one on each side of the car to be painted. The platform may be raised and lowered by two cable controls which extend from end to end. The platform is raised when one cable is pulled and lowered when the other is pulled. Safety devices limit the maximum and minimum height to which the platform will go.

b. Platforms should be made of expanded metal which presents a nonskid surface and enables the workmen to see through the platform. Thus, work can proceed on at least two different levels of any side of the car at the same time, be- cause the platform for the upper level workmen can be raised so it does not interfere with the men standing on the floor and working on the lower part of the car.

CHAPTER 19

SHOPS, LIGHT (RUNNING) REPAIRS

Section I. CAR REPAIR PLATOON, TRANSPORTATION RAILWAY EQUIPMENT MAINTENANCE COMPANY, TRANSPORTATION RAILWAY BATTALION, TOE 55-228

19-1. Mission and Capabilities

The mission of the car platoon is to inspect, condition, and make running repairs (light repairs) on railway cars. This unit is adequate to inspect, condition, and make running repairs to approximately 800 railway cars per day and to perform running inspections for approximately 2,0.00 rail- way cars per day. Normally, the TOE for the car platoon, transportation railway equipment maintenance company, transportation railway battalion, will include only equipment necessary to per- form the above functions. In theaters of operations, the TOE equipment may be greatly augmented by facilities and equipment contained in existing shops, particularly where damage to car shops is small.

19-2. Planning Factors

a. General. The shortage of all types of cars in a theater of operations makes it essential that repair tracks be designed and equipped to complete such repairs in the shortest possible time. This is even more Important on a repair track where an appreciable percentage of the cars handled are loaded. Delay in Inspection, classification, switching, repairs, and return of the car to service means delay in the receipt of the shipment by the consignee.

b. Track Facilities. There are a number of factors which should receive serious consideration when planning new, or remodeling old, light freight car repair facilities to provide the most efficient operation

(1) The operation of the light repair shop is particularly important. It should be adjacent to a classification yard or terminal yard so that bad order cars can be placed in the repair yard without delay. Practically all classification yards have a sizable repair track so located that a switch engine can readily place and remove cars.

(2) The repair yard should be provided with through tracks and a switching lead at both ends. With such an arrangement, switching moves are reduced to a minimum. The size of the repair track layout will depend entirely on the number of cars to be repaired in 24 hours, the extent of such repairs, the types of cars, the frequency of switching, and the size of the repair force. A careful study should be made of the maximum number of cars to be repaired at one time to determine track standing space required.

Section II. LIGHT FREIGHT CAR (RUNNING) REPAIRS

19-3. General

a. This section discusses the ideal standards for light repairs and facilities. The situation in the oversea area concerned will dictate the degree to which these standards can be adopted.

b. Light freight car repairs can be considered as comprising repair, renewal, or overhaul work which can be completed in 1 to 3 days (usually not exceeding 40 hours). Such work includes one or more of the following operations:

(1) Replacing journal boxes.

(2) Replacement, repair, or cleaning of airbrake equipment.

(3) Renewing brakeshoes, levers, rods, or pins.

(4) Changing worn or defective wheels, truck side frames, bolsters, or draft gear.

(5) Renewing or repairing ladders, steel running boards, platforms, door hinges, latches, etc.

(6) Patching, renewing, or repairing corroded or broken plates, angles, side stakes, center sills, and steel underframe parts.

(7) Patching or replacing wooden floors, lining, running boards, etc.

(8) Repairing sides, ends, or roofs.

(9) Installing, adjusting, or repairing special loading devices.

(10) Repairing cars for upgrading to receive a higher commodity classification.

(11) Restenciling required.

c. The preparation of cars for higher commodity loading is an important function of any light repair yard. Cards for commodities such as flour, grain, sugar, perishable rations or supplies, and similar materials subject to damage must have good floors, sides, and roofs to prevent rain, ice, snow, or cinders from entering. Boxcars for this type of loading should be reworked on the repair track to insure their continuance in such service.

19-4. Light Repair Track

a. The physical size of the repair track facilities will depend upon the volume of the work to be performed. A small repair shop located at the end of a branch line or at a small yard where 10 or more men are stationed (exclusive of train-yard inspectors or oilers) should have buildings for an office; latrine facilities; and a storeroom to house all material except wheels, bolsters, truck sides, couplers, and draft gears. The operation may be so small that a shed, roof, or building over the repair track is not justified, except in areas where extremes In weather are encountered.

b. A hard-surface pavement should be provided at the side of or between the working tracks to form a roadway and to permit jacks, wheels, couplers, draft gear, etc., to be hauled from storehouse or storage platforms to a car undergoing repairs The platform should be extended to provide a connection with storehouse, shop buildings, and an access road. The access road will permit material and supply trucks, ambulances, and firefighting equipment to reach the repair shop facility.

c. A minimum facility should also include a crane truck, a pillar crane, or a jib type crane with a power hoist for loading and unloading wheels. A crane truck is desirable, since it can be used for handling all types of heavy material In addition to loading, unloading, and handling wheels.

d. An air compressor with necessary piping and outlets at all convenient locations is essential. An electrical distribution system should be provided with outlets for an electric welding set, electric tools, and floodlighting if necessary for night shift work.

19-5. Large Repair Tracks

a. The layout of a large repair track where 50 or more car repairmen are stationed is dependent primarily upon the plan of operation Either the cars requiring repairs are placed at one repair position in the yard, and men, tools, and materials are moved to each car, or, if the spot system is used, the cars to be repaired are moved from one point to another for progressive repairs, and cars which require wheel changes are segregated. Cars for wheel change-out or other repairs are placed on one or more tracks and moved successively to a location provided with permanent jacking pads or blocks, pneumatic jacks, and a fixed or portable frame or hoists for dismantling and assembling truck sides, bolsters, etc. The wheeling location must be adjacent to wheel storage tracks equipped with a crane, dolly car, or turntables for easy movement of wheels to and from the working area.

b. The spot system for miscellaneous light repair work can be used effectively in those repair yards where the cars to be repaired are predominantly of one class or type. This would be true In a yard in a coal area where hopper cars are handled, at a tank car terminal near a refinery or oil-producing section, or at, a terminal or yard for refrigerator cars, etc. The spot system has many advantages where the type and volume of work permit At repair positions, material, tools, and supplies can be stored in bins, racks, or cupboards adjacent to the location where they are to be used. This saves delays and manhours and reduces the time required to move from one car to another.

c. It is difficult to have a repair track operating on the spot system if all types of loaded or empty cars must be handled and if repairs vary from light operations such as the renewal of running boards, repairs to safety appliances, etc., to straightening or renewing bent sheets, ends, or doors, or other heavy work on open-top or enclosed cars. It is possible, however, to use the spot system for wheeling cars, even though its use on the repair track is not justified. The cooperation of the train operating company is essential to the success of such an arrangement, since cars requiring wheel change must be

segregated from other bad-order cars, and this necessitates extra switching A careful study is required of all factors to determine which system to use.

19-6. Shop Buildings

a. It is desirable, particularly at a small car repair facility, to house all shops, offices, etc, in one building, for convenience. Provision of plumbing, heating, light, and other services is simplified.

b. Offices should be provided for the foreman and clerks with a small locker room, toilet facilities, and file storage for office personnel

c. Washrooms and locker rooms should provide latrines, washbasins, and shower stalls. Individual lockers for car repair platoon personnel are required for storage of uniforms, individual weapons, and other items of military equipment not needed on the Job.

d. Building space is necessary for heating boilers, air compressors, and fire pumps, if these services are not available from a nearby shop.

e. Toolroom space is essential for storage and protection of jacks, portable tools, air hose, oxyacetylene torches, electric welders, cable, and hand tools.

f. Because of fire hazards, the building for storage of waste, prepared packing, and oil should be of fireproof construction and be separated from other buildings It should be large enough for packing vats or tanks, as well as for storage of a carload of waste.

g. The airbrake room or building furnishes space for the storage of reconditioned airbrake components If the volume of work justifies, this room should be equipped with necessary test racks and plates.

h. Pipe and sheet metal repairs normally will not require a great amount of space, and the necessary machines can be installed at one of the fabricating shop or planing mill. The blacksmith shop, particularly at a small shop, may also be combined with other shop facilities It is preferable, however, to have it in a separate, well ventilated room or building, because of the fumes, dust, and dirt resulting from its operation.

i. A room or building is essential to house machinery for fabricating operations on steel and for drilling, threading, and grinding This space should be convenient to storage platforms, driveways, and working areas and should provide ample room for handling large plates.

j. The wood mill and planing mill present certain fire hazards and should be in a separate building or have a firewall separating them for adjacent shops or facilities. Lumber must be reworked for use as flooring, siding, or sheathing in camp cars and cabooses. It is also desirable to provide a shed near the wood mill for the storage of lumber An open-side shed should have an overhanging roof to protect the lumber from driving rains.

k. The paint shop can be a small room or building, since the average light repair track will not attempt any extensive painting operations. It should be protected from fire hazards. Space should be available for the storage of paint, stencils, and supplies.

l. In addition to the service buildings, serious consideration should be given to the desirability of providing a shed or an enclosed building over the repair track area. Elimination of lost time and delays due to bad weather may justify the construction.

m. The amount of machinery and equipment to be provided will depend upon the volume and type of work to be performed The small repair yard, and in many cases even the larger yard, can be supplied with prefabricated parts, precut lumber, and reconditioned airbrake, truck, and draw gear assemblies from a central location

n. TOE equipment is considered sufficient to perform 1- to 3-day repairs, usually not exceeding 40 hours.

o. The storehouse room or building should have adequate space for storage of bolts, nuts, small materials, and supplies in bins, racks, or cupboards. Heavy items of car material can be stored on outside racks or platforms, since this type of material is not affected by the weather.

p. Wheel storage tracks preferably should be arranged at right angles to the repair tracks. Sufficient double storage tracks should be provided to permit classification of wheels by journal sizes, steel or cast iron, new or reworked.

19-7. Materials Handling Equipment

a. The importance of providing adequate materials handling equipment cannot be over emphasized. Its use in loading, unloading, and moving materials and supplies will expedite car repair work, reduce delays, and effect considerable economies in operation.

b. The well-equipped car repair yard should be provided with a truck crane of 8,000- to

10,000-pound capacity. Among other things, this unit can be used to load and unload wheels and heavy materials, carry mounted wheel sets to and from the storage tracks, handle doors in repair operations, straighten car ends, and shift loads It is much more versatile than the locomotive type of on-track crane.

c. A forklift truck can be used to handle material on skids, mounted wheels, and other similar items and to assist in actual repair operations. Similarly, a tractor with trailers is a valuable piece of equipment. The tractor, If of adequate capacity, may be used occasionally for shifting cars.

d. Small platform trucks are desirable for hauling light materials and supplies from the storehouse to the point of use. Oxyacetylene tanks, electric welders, or supply cabinets can be mounted on platform trucks for mobility.

e. Hand wagons, trucks, or buggies are valuable for moving tools, supplies, or materials. If this equipment is to be hand propelled, it should be as light as possible and be equipped with ball or roller bearings on axles.

Section III. LIGHT PASSENGER CAR (RUNNING) REPAIRS

19-8. General

Light passenger car maintenance is interpreted to mean running repairs and cleaning and servicing operations at coach yards and terminals before cars are again ready for service. The work involved includes everything from repairing a door latch to changing out slid-flat wheels It includes replacing a defective light, fixing inoperative air conditioning equipment, inspecting running gear and safety appliances, testing airbrakes, cleaning and touching up car exteriors and interiors, checking batteries, and putting all required supplies aboard.

19-9. Coach Yard Layout

Coach yard tracks should be spaced so as to assure sufficient width on the runways to permit material and trucks to pass each other. It will also permit trucking around men who are working under the cars or occupying part of the runway with their material and apparatus without interference with their work. Steam, air, water, and electric outlets can be located along the center of the runway from either overhead or underground lines extending to the boiler plant. The powerplant will of necessity include one or more air compressors, electrically or diesel engine driven

19-10. Wheel and Truck Repairs

a. Car wheels are subject to many defects, discussed in chapter 4, the repair of which necessitates the removal of the axle with its pair of wheels. Removal of complete trucks because of defects is infrequent, as compared with the removal of mounted wheels. Most coach yards are equipped with facilities to remove and replace pairs of wheels and complete trucks, the kind or extent of facilities varying with the amount and character of the work in each yard. In large terminals, pairs of wheels are changed on pneumatic or hydraulically operated wheel-dropping jacks usually equipped with V-blocks to engage the axles Trucks are released by means of hand or power-operated jacks that lift the car sufficiently to permit the trucks to be rolled from it.

b. Drop-pit tables simplify the operation, as the rails spanning the pit are a part of the movable table Wheels supported on these rails can be removed without any part of the lifting mechanism coming in contact with the axle. This type of equipment should have the following characteristics:

(1) A capacity sufficient to raise a pair of wheels above the rails spanning the pit.

(2) Detachable tabletops to engage the wheel treads instead of the axles, so as to avoid having to strip the axles of pulleys or other attachments.

(3) Electrical operation to provide a low cost source of power and to permit the use of remote control.

19-11. Inspection Facilities

a. In most cases, complete inspection can be accomplished best at inspection pits. With the exception of a pit track of required capacity for inspection, the general requirements in terminal facilities for passenger cars usually are included in the servicing facilities of a coach yard. Consideration should be given to the location of the 'inspection pit track at a coach yard to permit maneuvering the train into the faculties without delays and to reduce switching operations to a minimum.

b. The car unit capacity or length of the inspection pit, and the necessity for components servicing facilities at the pit track, such as usually are maintained in passenger car servicing

yards, depend upon the requirements and the tactical situation in the theater of operations. The number of trains requiring terminal inspection, repairs, and servicing; the length of trains; and the schedules or layover time are factors to be considered.

CHAPTER 20

WELDING

Section I. GENERAL

20-1. Preparation

Welding by any process requires the utmost care and good judgment on the part of the welding operator The operator's ability to perform the work in question satisfactorily by the process selected must be ascertained by the officer in charge of the shop. The edges of pieces to be welded must be prepared as shown in figure 20-1. If both sides of the fractured member can be worked upon, the fracture should be prepared as in figure 20-1(1) When only one side of the fractured member is accessible, figure 20-1(2) should be followed. The entire crack or fracture, must be cut out with a cutting torch or chipped or ground out for a sufficient distance, so that no portion of the crack remains. The surfaces upon which new material is to be deposited must be clean and reasonably smooth. If the surfaces are prepared by flame-cutting, the oxide scale must be removed before welding is started On malleable iron or cast iron, any flame-cut surface and affected area must be removed by chipping or grinding. Particular attention must be given to running boards, brake and dome steps, and platforms to insure that all the galvanized metal has been removed.

20-2. Welding Methods

Generally, it is good practice to employ multiple pass welding in layers approximately 1/8 inch thick laid with a slight oscillating movement of the electrode. In oxyacetylene welding or bronze welding, the weld deposit should be made with a single pass. Complete welds should follow the contours shown in figure 20-2 Heavy reinforcement is neither necessary nor desirable. The weld should be finished so as not to produce a notch effect at the junction of the weld with the parent material, and every precaution should be taken to avoid abrupt changes in section thickness at the line of fusion The deposited metal must be dressed to the required dimensions After welding has been completed on running boards, brake and dome steps, and platforms, all iron oxide scale must be removed and a protective coating applied.

20-3. Heat Treatment After Welding

a. Parts for which annealing, normalizing, or stress-relieving is required should be heated to the required temperature at a rate not exceeding an increase of 500° F temperature per hour and held at the specified temperature 1 hour for each inch of maximum thickness of material. Material must not be charged into the furnace initially, if the furnace temperature exceeds 700° F. Furnace and material temperatures must be measured with pyrometers (recording pyrometers preferred).

b. The annealing temperature should be 1500° to 1600° F The material should be allowed to cool to a temperature of 500° F. or lower in the annealing furnace.

c. The normalizing temperature should be 1500°0 to 16000F. Material removed from the furnace at about this temperature and allowed to cool in shop air should be protected from drafts and weather.

d. The stress-relieving temperature should be 1200° to 1250° F. If a furnace is used, the material should be removed and allowed to cool in still air Local stress relieving of material is permissible by heating the part to a red heat with a blowtorch and allowing It to cool in place.

e. When truck side frames, bolsters, or the knuckle sidewall of coupler heads are welded, a record must be stamped by at least 3/8-inch stencils on the weld or immediately adjacent thereto (surface of part to be smoothed off by grinding or other means before stamping) to indicate the organization reporting marks, the date, shop identifying symbol, and welder's identification number or mark. These markings should be in the following form:

Reporting marks_____
Shop identifying symbol_____
Date_____
Welder's mark_____

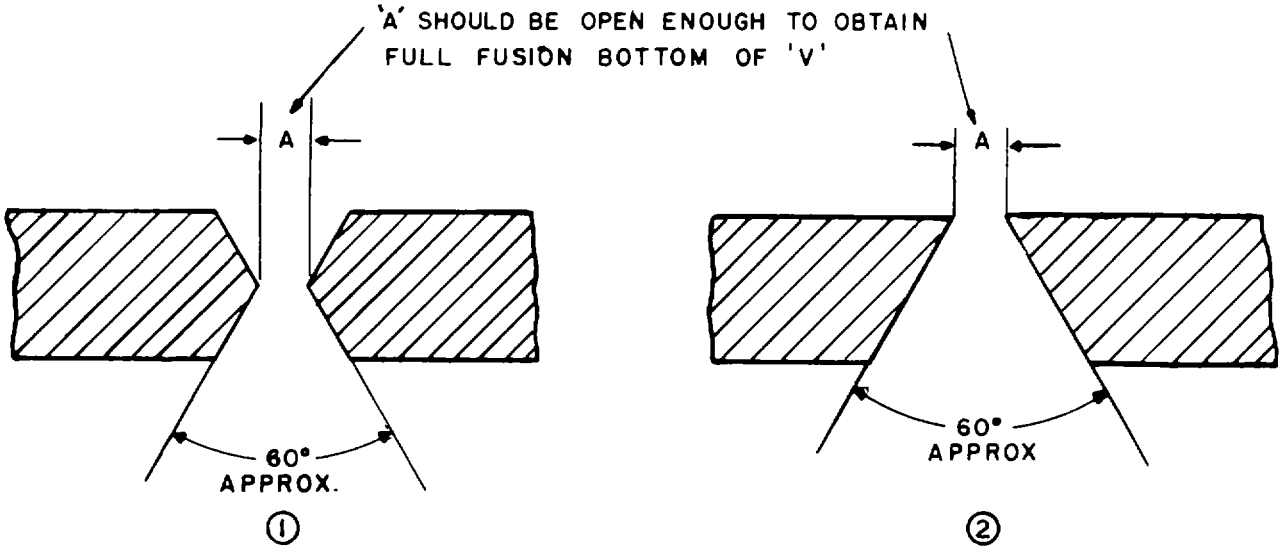


Figure 20-1. Preparation of edges.

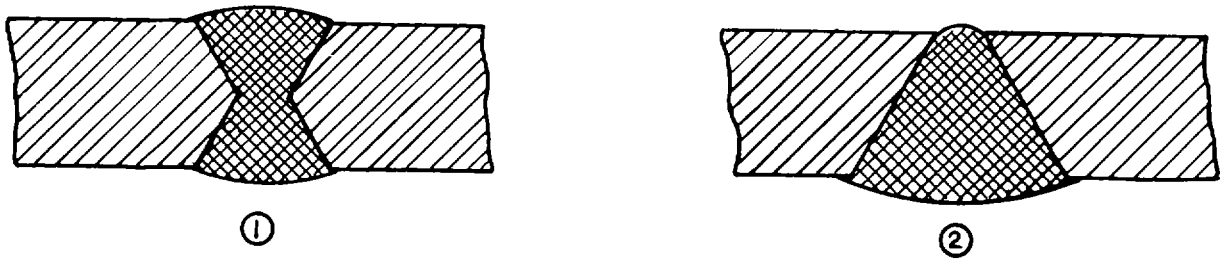


Figure 20-2. Weld contours.

Section 11. WELDING LIMITATIONS

20-4. General

Unless otherwise provided, welding by either the electric or oxyacetylene process will be permitted on parts within the limitations referred to, except that parts made of high alloy steel subject to severe brittleness must not be welded nor have fusion heats applied to them. Heat-treated carbon steels must not be welded nor have fusion heats applied to them unless such parts can be heat treated again (duplicating the original heat treatment) after welding to restore former properties.

Car parts other than those listed in paragraphs 20-5 to 20-8 may be repaired by welding, provided the welded metal joint equals or exceeds the physical properties of the section welded. Where it is permissible to weld malleable iron parts, it is mandatory to use the oxyacetylene (or equivalent gas) bronze welding process for making repairs in sections subject to tensile stresses. For malleable iron sections subject to compression stresses only, it will be permissible to use the arc-welding process. Care must be exercised to

see that the general condition of the part to be repaired is not due to defective material or weak design, conditions which are often evidenced by the existence of previously made welds. Such parts should not be repaired.

20-5. Limitations on Reclamation

Specific limitations on reclamation by either electric or oxyacetylene welding are as follows:

a. Axles, Solid. No welding permitted.

b. Bolsters, Cast Steel, Grade B. Welding cracks or fractures from the end to within 12 inches of the center plate (as shown in AAR Interchange Manual) is permissible, providing crack or fracture does not extend more than forty percent through the cross-sectional area of the casting. Welding cracks outside of this area is prohibited. Bolster must be removed from car before welding and normalized after welding.

c. Bolsters, Cast Steel, Grade C and High Tensile Steel. Welding limitations as discussed above, except that castings shall be uniformly preheated to a temperature of between 300° F and 6000 F and the welding shall be accomplished while the casting is maintained at a temperature of above 3000 F.

d. Bolsters, Pressed- or Structural-Steel. No restrictions.

e. Braces, Body. No restrictions

f. Brake Beam Tension Members. No welding of cracks or fractures or building up permitted.

g. Brake Steps Metal. No welding permitted except for restoring original construction weld.

h. Carlines. No restrictions.

i. Center Plates, Malleable Iron. Must be removed and be bronze welded.

j. Center Plates, Cast or Forged Steel. No restrictions. If removed from car, it is recommended part be stress-relieved after welding.

k. Check Plates, Follow. No welding permitted when section is broken out between key slots.

l. Couplers, Rigid Shank Lengths. May be restored by welding.

m. Couplers, Swivel Shank, Lengths. May be restored by welding. Must be normalized after welding.

n. Couplers, Key Slot. May be restored by welding. Must be normalized after welding.

o. Coupler Draft Keys. No welding permitted.

p. Coupler Knuckles, High Tensile. Worn surfaces may be built up by welding.

q. Coupler Knuckles, Grade B. No welding permitted.

r. Coupler Pins. No welding permitted.

s. Coupler Yokes, Horizontal, Forged Steel. No welding permitted.

t. Dome Steps and Dome Platforms. No welding permitted, except for restoring original weld.

u. Draft Lugs, Cast- or Forged-Steel. No restrictions.

v. Equalizers, Truck. No welding of cracks or fractures permitted

w. Grabirons. No welding permitted.

x. Hanger, Brake Beam. Cracks and fractures must not be welded. Building up worn eyes is permissible.

y. Hanger, Spring or Bolster. Crack or fractures must not be welded. Worn areas may be built up provided material remaining in part is not less than 80 percent of the original section. Must be normalized after welding.

z. Hanger Bracket, Brake Beam. Cracks or fractures may be welded. Normalizing is required, if weld is located closer than 1 inch from inside flange of side frame. Brake hanger brackets may be renewed or other types substituted by welding. Normalizing is required, if weld is located closer than 1 inch from inside flange of side frame. Building up worn holes is permissible.

aa. Heads, Brake Beams, Cast Steel. No restrictions.

ab. Journal Boxes (Not Integral), Cast Steel. No restrictions.

ac. Journal Boxes (Not Integral), Malleable or Cast Iron. No welding permitted.

ad. Ladders and Supports. No welding permitted.

ae. Levers, Brake. Cracks or fractures must not be welded Holes may be built up provided material remaining in part is not less than 80 percent of the original section.

af. Plates, End or Side. No restrictions.

ag. Posts, End, Side, or Door. No restrictions.

ah. Reservoirs, Auxiliary and Emergency Airbrake, Cast Iron. No welding of body portion permitted. Worn holes in lugs may be built up, and lugs fractured or broken off beyond 1/2 inch from body may be reclaimed by bronze welding.

ai. Running Boards, Metal (Steel) (Except Tank Cars). Running board sections must be removed from car for welding repairs.

(1) Longitudinal running board between the end running board saddles-welding of cracks and fractures permitted up to 50 percent of sectional area of complete section.

(2) Longitudinal running boards extending beyond the ends of car-no welding permitted except to restore original construction weld.

(3) Latitudinal running boards-welding of cracks and fractures permitted up to 50 percent of sectional area of complete section.

aj. *Running Boards, Aluminum*. No welding of cracks or fractures permitted.

ak. Running Boards, Steel (Tank Cars Only). Only welding of cracks or fractures in running board sections permitted, except to restore original construction weld or if over running board support. Welding in connection with splicing of running board sections over body bolsters, center sills, and cross supports for purpose of renewing sections at these locations permitted.

al. Sheets, Body or Roof. No restrictions.

am. Sill Steps and Their Supports. No welding permitted.

an. Shaft, Brake. No welding permitted.

ao. Stakes. No restrictions.

ap. Spring, Planks. No restrictions except that, where thickness is reduced to less than 1/4 inch owing to corrosion, spring planks must not be welded. Spring plank must be removed for welding.

aq. Tanks of Tank Cars. Welding of any kind is not permitted on tanks of tank cars unless the shop performing such welding is certified by the AAR. For welding repairs to tanks of riveted or welded construction, all applicable requirements of currently effective DOT Regulations for Transportation of Explosives and other Dangerous Articles, and Appendix R, AAR Specifications for Tank Cars must be fully complied with before cars are restored to service.

ar. Top Chord Angles of Open-Top Cars. No restrictions.

as. Transom Truck (the Crossmember of Each Side of Bolsters Which Tires the Side Frames Together). May be welded in place by removing truck from underneath the car body.

at. Truck Sides, Cast Steel. Building up worn surfaces and welding cracks within certain areas or welding performed on other parts extending from frame members, such as tie strap lugs on Andrews type side frames, where the weld is over 1 inch from the frame member, is permissible on side frames of U-section design manufactured (as indicated by foundry marks) in 1926 or before. The material remaining in the part to be built up must be equal to 60 percent of the original section, or the area of the crack must be less than 40 percent of the total area through the section at the point of fracture. Welding or other cracks or fractures is prohibited. Brake hanger bracket repairs or renewals may be performed, however, as outlined in z above.

au. Truck Sides, Pressed- or Structural-Steel. No welding permitted.

av. Uncoupling Levers. No welding of cracks or fractures permitted.

aw. Wedges, Journal Bearing. AAR standard drop-forged or cast-steel wedges removed from service because they have reached the limit of wear may be reclaimed by reforging or fusion welding and restored to new dimensions. Wedges thus reclaimed will be classified as new. Journal bearing wedges may also be reclaimed by machining or grinding provided-

(1) Original top contour of wedge is formed to 50-inch radius.

(2) Nominal thickness of crown is not reduced more than 3/32 inch.

(3) Lengths over contract surfaces are restored to nominal dimensions if reduced more than 1/16 inch. Wedges thus reclaimed will be classified as secondhand.

ax. Wheels, Brake. No welding of cracks or fractures permitted.

ay. Wheels, Car, or Tires. No welding permitted.

20-6. Welding Regulations for Couplers and Cast Steel Yokes

Welding is permitted for couplers and cast steel yokes under the following regulations:

a. Welding practices permitted under these regulations are confined to couplers and yokes made of grade B carbon steel. The work must be done only under expert supervision and only at reclamation plants where facilities such as heat treating furnaces using pyrometers (preferably recording pyrometers) and other essential safeguards are provided, so that quality and uniformity of results may be assured. All existing rules and restrictions with respect to welding of couplers and yokes remain in full force except as herein modified.

b. Cracks In couplers and cast steel yokes are welded by the electric process, using a shielded arc electrode.

c. Cracks in couplers must be prepared for welding by single veeing as shown in figure 20-1(2), so that the welding can all be done from the outside.

d. Cracks in yokes, if both sides of the fractured member can be worked upon, should be prepared as shown in figure 20-1(1) and the welding done from both sides. If only one side can be worked upon, preparation should be as shown in figure 20-1(2).

e. In all cases, the entire crack should be cut out far enough back so that no portion of the crack remains in the metal, and the surfaces where new metal is to be deposited are clean and reasonably smooth.

f. If a gas pocket encountered when cutting out a crack or making a weld cannot be entirely removed, the part must not be reclaimed.

g. On couplers, welds must be dressed off, so that there is no projection on the front face, inside the guard arm, or at the bottom of the shank. Also, no projections or beads which might interfere with operation of the coupler will be allowed inside the knuckle or lock cavities.

h. On yokes, welds must be dressed off flush with parent metal on the inside and outside of ,straps and in the key slots. Front end of key slots must be gaged from rear bearing surface of yoke to insure equal lengths on each side of the yoke so that it will line up properly in assembly. After welding, couplers and cast steel yokes must be normalized. No welding is permitted on forged steel coupler yokes.

20-7. Welding Coupler Cracks

a. Transverse cracks, including shrinkage cracks in the shank of the coupler from the rear end of the shank to and including the backwall of the horn, may be welded There is no limitation in length or depth of cracks that may be welded.

b. Cracks in the guard arm and the front face of the coupler, including cracks extending the full length of the face into the lock opening and into top and bottom parts of the wall, may be welded. If a crack is more than 1/16 inch wide, parts should be pressed back to original contour before welding is done.

c. A coupler having a 5- by 7-inch shank with a 6 1/2-inch butt may be converted to one with a 9 1/8-inch butt by welding metal shims on the top and bottom of the butts in accordance with the following regulations:

(1) Shims must be cut to proper size 1 5/16 by 5 by 5 1/2 inches.

(2) Shims will be drilled In pairs to match holes in related coupler butts.

(3) Coupler butts will be ground to give neat seating of shims.

(4) Shims will be beveled 3/8 of an inch to 60° angle (or J-weld preparations given) for all around contact face. No beveling of the coupler butt is permitted.

(5) Shims will be tightened to welding position on the coupler butt by dummy pin and key, and care will be exercised to see that shim edges are flush with corresponding edges of the coupler butt.

(6) After shims are in position, they will be welded to the coupler butt by the shielded arc electric method.

(7) All sharp corners of applied shims must be removed by grinding.

20-8. Cast Steel Yokes

a. Cracks in straps not closer than 3 inches to junction with the rear of the yoke may be welded regardless of extent or direction of the crack. If a crack stands open, a means must be used to hold the severed ends alined in proper relation while welding, so that the length of the crack is not changed.

b. Cracks anywhere in the front section of the yoke, including the key slot, may be welded.

c. Cracks in the rear end of yokes, including 3 inches of adjacent strap, must not be welded.

CHAPTER 21

SAFETY

21-1. Accident Prevention Program

a. A sound, practical accident prevention program is essential in decreasing accidents in the car repair yard. Some of the elements that contribute to the success of such a program are--

(1) Establishment of a shop safety committee, the membership of which should be chosen, in large part, from the rank and file and given authority to enforce safety regulations.

(2) Establishment of sound safety rules and

instruction In their observance.

(3) Enforcement of the rules

(4) Instruction in safer ways of doing each job.

(5) Instruction in first aid.

(6) Fixing of responsibilities from top to bottom.

b. The following cautions are suggested in fixing responsibilities:

(1) The usual causes of accidents should be known.

(2) Snap judgments must be avoided. An investigation should be conducted in each case to determine the causes for the accident.

(3) Determination should be made of the reason why the safe method was not followed.

(4) Investigation should reveal whether any unsafe condition was involved and why it existed.

(5) Action should be taken to prevent a recurrence.

21-2. Safety Rules

a. Safety rules are for the protection of personnel, as well as for the safeguarding of Government property. All personnel engaged in the maintenance of railway cars must be conversant with and obey the safety rules and special instructions. Situations not covered by the rules demand sound judgment in applying correct principles of safety.

b. It must be realized that the rules contained herein cannot be considered as all inclusive, since time and conditions will dictate additions and deletions They do, however, cover the major safety hazards involved in the maintenance of railway cars Detailed railway safety rules are contained in DA Pam 55-1, a copy of which should be in each shop worker's possession.

21-3. General Rules

a. Persons in charge of work are responsible for the safety of the men under their supervision, including those temporarily borrowed or transferred from another division This does not preclude individual responsibility. Personnel are responsible for their own safety and will not depend upon others to apply the safety rules for them.

b. Inexperienced personnel must be properly instructed in safe methods of performing their work.

c. Personnel will familiarize themselves with tools, appliances, and equipment before use, making certain that their condition is safe.

d. Personnel will not cross, sit, or lie under cars, except in performance of duty, and then only when protection is afforded

e. Personnel will look in both directions before crossing, walking parallel to, or standing close to tracks. They must walk clear of tracks when duties permit and against the current of traffic A lookout must be kept in both directions for approaching trains or cars.

f. Personnel will not step or walk on rails, frogs, switches, or interlocking machinery except when necessary in the performance of duty.

g. Material will not be placed close to or between tracks, but must be moved to a site where safety is assured.

h. Care will be exercised to avoid injury from protruding nails When practicable, nails should be bent down or removed.

i. Personnel will not use hammers, mauls, picks, etc., without sufficient room, except In emergencies.

j. Personnel will not ride on cranes or attached idler cars, except In the performance of

duty, and then only after a proper understanding with the crane operator.

k. Horseplay of any kind is prohibited.

l. The use of compressed air to blow dirt from clothes is prohibited.

m. Ear coverings which interfere with hearing will not be worn by personnel.

n. Flagging equipment will be used only by authorized personnel, except in an emergency.

o. Dangling wires will be avoided. If it becomes necessary to handle a dangling wire, a non-conducting substance will be used or qualified assistance will be secured.

p. Persons must be suitably clothed to perform their duties safely. Trousers or overall cuffs should be tied.

q. In dangerous places where authorized routes to yards, shops, stations, etc., are provided, the use of other routes is prohibited.

r. Standing near a cable, a rope, or a chain under tension, or when a heavy pull is being made, except when absolutely necessary. In the performance of duty, is prohibited.

s. Unnecessarily working, walking, or standing under other workmen, where tools or materials are likely to fall, is prohibited. When it is necessary to do so, the men above will be notified.

t. Removing material or supplies from, or placing them in, a keg, a barrel, or a box before protruding nails, staples, or loose ends of metal bands or wire have been removed is prohibited.

u. Placing or leaving equipment, tools, or other material where they will constitute a tripping or slipping hazard or where they may be struck by a train or other moving equipment is prohibited.

v. Operating machines, switches, valves, or other apparatus with a "Danger-Do not operate" sign attached is prohibited. "Danger-Do not operate" signs, tags, or banners will be removed only by the person who placed them 'there, and then only when it is safe to do so.

w. Cutting off the heads of bolts or rivets without using a broom, bagging, or similar object as a shield is prohibited.

x. The prescribed gloves, goggles, and other necessary protection will be worn when handling or working with battery acid, caustic soda, lye, oxalic acid, or other chemical injurious to the skin.

21-4. Prevention of Burns, Fires, and Explosions

a. Personnel will keep sufficiently covered as a protection against burns. Smoking will be permitted only in authorized or unrestricted areas.

b. Smoking material will be extinguished before it is discarded.

c. Rubbish will be disposed of daily or as often as necessary.

d. Lockers will be inspected periodically. Use of lockers of materials other than metal should

be discouraged.

e. Oily waste and other flammable material should be kept in approved metal containers and disposed of daily.

f. Combustible material should be kept a safe distance from all heating units.

g. Kerosene, gasoline, or other volatile liquids should not be used to start fires.

h. Motor cars should be refueled outside buildings. Ignition should be shut off and the engine stopped before refueling.

i. If it is necessary to refuel equipment from a portable can, only an approved safety can

should be used.

j. Only proper size fuses, standard wiring, and approved electrical appliances should be used.

k. Extension lights should be kept in good order and protected by suitable guards.

l. Outlets carrying voltage higher than 110 to 130 volts should be plainly marked with correct voltage.

m. Personnel will not hold a torch, an open light, or a heated object near a storage battery or a tank or other container which holds or has recently held gasoline or- other highly flammable liquids.

n. Storing or handling gasoline or other highly flammable liquid in other than approved containers is prohibited.

o. Smoking or using a torch, lantern, or other flame within 50 feet of gasoline being transferred from one container to another is prohibited.

p. Removing the filling plug while a gasoline blowtorch or furnace is burning is prohibited.

q. The filling plug on a blowtorch or a furnace will be replaced immediately after filling. The torch or furnace will be examined for leaks and to see that the filling plug is tight before lighting.

r. Using cutting or welding apparatus, hot rivets, or other source of heat while working on or in a container which has been used for oil, gasoline, or other flammables, is prohibited until

all traces of such material have been completely removed.

s. Personnel will stand clear of a door or opening when lighting an oil or gas forge, furnace, or heater.

t. When a furnace, a forge, or other such equipment is being extinguished or shut down, the fuel supply must be shut off before the air is turned off.

u. Throwing gasoline, kerosene, or other flammable liquid in a refuse can is prohibited.

v. Placing wet, damp, or cold material, tools, or other objects in molten metal is prohibited.

w. Cleaning with steel wool or steel brush around a tank or other place where gasoline or kerosene fumes may be present is prohibited.

21-5. Handling Material

a. Sprains and strains are frequent among personnel engaged in the maintenance of railway cars These injuries could be avoided if personnel would follow these basic rules when lifting objects:

(1) Lifting beyond normal physical capabilities is prohibited.

(2) Footing must be secure.

(3) The strong arm and leg muscles should exert the force of lifting. Figure 21-1 shows right and wrong methods of lifting a heavy object. In the arched position depicted in figure 21-1(1), the weak muscles of the spinal column and the sacroiliac exert the full force. The squatting position shown in figure 21-1(2) requires the large muscles of the legs and arms to take the load. The man crouches and gets a good grip He then straightens his legs slowly, and the box comes up with the least strain on the muscles of the back.

b. When it is necessary for two or more persons to handle heavy or bulky materials by hand, the following precautions must be taken:

(1) Slipping or tripping hazards will be removed when practicable.

(2) One person will be designated to give commands for all movements (lifting, walking, lowering, or throwing). When practicable, this individual will be placed at one end of the object being handled.

(3) The person designated to give the commands must fully inform those assisting him of what is to be done and what the words of command will be.

(4) Commands by other than the designated person are prohibited.

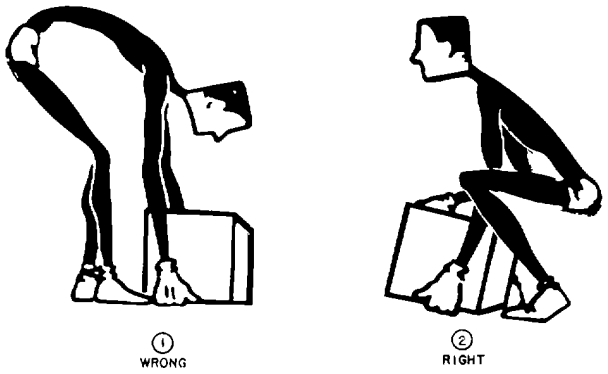


Figure 21-1. Right and wrong positions for lifting.

(5) Men will be placed according to size, strength, and experience.

(6) Walking backwards will be avoided whenever possible.

(7) Unnecessarily loud talking when handling material is prohibited.

c. Material will be piled and stowed in a safe and orderly manner.

d. Tools and material not in use will be kept a safe distance from the edge of platforms or tracks and clear of aisles and runways.

e. Personnel must be prepared to stop short of persons or objects, especially when going through or past doors, gangways, or other passageways.

f. Walking backwards while pulling trucks or wagons is prohibited.

g. Mounted wheels will be stopped by exerting a pull on the axle from the rear. Stopping wheels by taking hold of the flange is prohibited

h. Leaving wheels, mounted or unmounted, before they are stopped and secured is prohibited.

i. Rubbing the face, arms, or any other part of the body with the hands while handling creosoted material will be avoided.

21-6. Use of Handtools

a. Employees must be sure that tools which they use in performing their duties are in proper condition. The use of defective tools is prohibited.

b. Standing on or straddling a bar or lever while using it is prohibited.

c. The following precautions must be taken when using a wrench:

(1) A solid-end wrench must be of the proper size to fit the object on which it is to be used, or another wrench will be properly adjusted.

(2) A monkey wrench or similar wrench will be placed so that the turn is toward the open side of the jaws.

(3) The use of any object, as a shim between a nut, a bolthead, or a similar object, and the jaws of a wrench, to make the wrench fit is prohibited.

(4) The body must be braced to avoid overbalancing in case the wrench slips, or wrench, bolt, nut, or other object fails.

(5) Before full force is applied, the wrench must have a proper grip; then force is gradually increased until nut, bolt, pipe, or other object turns. Jerking a wrench is prohibited.

(6) The use of a pipe or other object to extend the length of the handle, unless the wrench is designed to be extended, is prohibited.

d. Standing on the same side as the striker while holding a bar, a cutter, or a punch is prohibited.

e. When striking tempered or case-hardened objects, a soft hammer will be used or the object will be cushioned with wood.

. It is prohibited to use a file as a wedge or pry, to strike a file with metal, or to use a file without a handle.

g. It is forbidden to carry a file, an ice pick, or other pointed tools, unless the point is protected.

h. It is forbidden to leave a shovel, a fork, a rake, a hoe, or other pointed or edged tool with the pointed edge up when not in use.

21-7. Operation of Portable Power Tools

a. The operation of electric or pneumatic tools by personnel who have not been instructed in their use is prohibited.

b. It is prohibited to connect or disconnect a pneumatic tool before closing the valve at the supply line or draining the pressure from the hose.

c. Laying down an electric or a pneumatic tool while the motor is running is prohibited. Such a tool will be placed in a position where trigger, valve, or switch is shielded to prevent the tool from being accidentally started.

d. Leaving unattended a drill, a reamer, or a tap with an electric or a pneumatic motor attached is prohibited.

e. Attaching a drill, a reamer, a tap, or other tool to an electric or a pneumatic motor while the motor is running is prohibited.

f. Using a pneumatic hammer for riveting, unless it is equipped with a spring clip or other arrangement for holding the die or set in the hammer, is prohibited.

g. Pointing a pneumatic hammer at a person is prohibited.

21-8. Use of Jacks

a. Before the end of a car or a crane is jacked up, the wheels or end must be blocked.

b. After a car has been jacked up, trestles or blocks are placed under it. Going under or working on such equipment not so protected is prohibited

c. The jack should be set securely with proper contact at top and bottom.

d. A piece of wood should be inserted between jackhead and load when jacking against metal. Jacking metal against metal is prohibited.

e. The use of a handle which is not standard for the type of jack being operated is prohibited. The use of a bar or handle which does not fit is prohibited. f. Using the jack without the handle fully inserted in the socket is prohibited.

g. The handle must be removed when the jack is not being operated.

h. Personnel using a ratchet jack must stand at the side of the handle In a braced position and move the handle slowly and uniformly, being sure that the latches are fully engaged and that the body is clear of the handle before releasing pressure on the jack.

i. Using a jack of lower capacity than required for the job is prohibited.

j. Leaving jacks standing under load in shops or on repair tracks without support of trestles, horses, or blocks is prohibited.

21-9. Operating Oxyacetylene Equipment

a. The operation of cutting or welding equipment by unauthorized persons is prohibited.

b. Clothing and shoes that will give full body protection must be worn when cutting or welding operations are being performed. Wearing torn, oily, or 1 greasy clothing when performing welding operations is prohibited.

c. Attempting to repair a gas cylinder or valve is prohibited.

d. A gas hose, torch, gage, or regulator must be disconnected from the tank before being repaired.

e. Performing cutting, welding, or heating operations on a container, a corded casting, a pipe, plugged holes, etc. unless the material is properly vented or drilled to permit escape of gas, steam, or hot air is prohibited.

f. A flint lighter will be used to light a gas cutting or welding torch. Using a match or other source of open flame for this purpose is prohibited. The torch will be held in a downward position and in a direction away from other personnel.

g. Using oil or grease on a gas torch, gage, regulator, or hose connection is prohibited.

h. Before cutting through a sheet, a plate, or any other part, personnel must assure themselves that there is no one on the other side who might be burned.

i. Laying an object to be heated, cut or welded across s gas or an air cylinder is prohibited.

j. Leaving oxyacetylene torches on pressure lines, unless the valves at the other end of the hose are closed, is prohibited.

k. Throwing, dropping, or otherwise roughly handling a gas cylinder, whether empty or loaded is prohibited.

l. Allowing gas cylinders to stand near furnaces, steampipes, or other sources of heat is prohibited m. When the cylinder is not in use, the valve must be closed and the key removed. it. The use of leaking gas cylinders is prohibited Leaking cylinders will be removed to the open air to an area clear of flammable material or anything that will cause gas to Ignite.

o. Using an open flame or smoking in gas storage buildings is prohibited.

p. Using leaking hose or connections on gas cylinder is prohibited.

q. Changing or adjusting pressure on regulators with torch valves closed is prohibited.

r. Laying down a lighted torch is prohibited.

s. Passing a lighted torch from one man to another or climbing with a lighted torch is prohibited.

t. When cylinders are stored or in use, valves should be In an upright position.

21-10. Electric Arc Welding

a. Voltage, current, or polarity controls of portable machines must not be adjusted while they are under load. A resistor unit switch must never be opened or closed while current is passing through the unit.

b. An electrode must not be allowed to stick to work, causing a short circuit, longer than a few seconds. An electrode holder must not be left where it can be knocked or dropped on work, causing a short circuit. There must be no attempt to start a machine while a short circuit exists.

c. Worn or poorly connected welding cables must not be used.

d. An electric arc must not be looked at with the naked eye at a distance of less than 40 feet. Welders must completely surround an arc with a dark curtain or screen to protect other workmen from arc rays.

e. A cracked filter glass or a cracked helmet must never be used

f. Welding in confined places without suitable ventilation is prohibited.

g. Welding on hollow castings without providing vent holes for air In the cavity is prohibited.

h. Striking an arc on oxygen, acetylene, or other gas cylinders is prohibited.

i. Containers used for volatile or flammable liquids must not be welded until all traces of such material have been completely removed.

21-11. Use of Ladders, Trestles, Platforms, or Scaffolds

a. Personnel will face cars, scaffolds, trestles, or ladders when climbing on or leaving them A secure handhold and a firm footing are essential.

b. When climbing, it is prohibited to carry tools or material which prevent a secure handhold or which interfere with safe movement.

c. Placing a ladder on a box, a barrel, a block, or any other insecure object to extend its reach is prohibited.

d. Using a straight ladder not equipped with spikes or nonslip bases suitable for the surface on which it is to be used, unless lashed or otherwise secured, is prohibited.

e. A ladder in use at a location where persons or vehicles are likely to collide with it will be guarded by a man assigned for the purpose, or will be otherwise protected.

f. Use of weak, cross-grained, or otherwise unsuitable material for scaffolds, platforms, ladders, or handrails is prohibited.

g. Use of a scaffold or a platform made of loose boards, not equipped with end stops to keep them from sliding or coming off the supporting trestle, horse, brace, or bracket, is prohibited.

h. Reaching or leaning out more than an arm's length from the edge of a ladder, scaffold, or platform is prohibited.

i. It is prohibited for personnel to "walk" a ladder while on it.

j. A stepladder should be opened fully and the spreaders set before it is used.

k. When a ladder is used within the swing of a door or so as to obstruct a doorway, the door will be locked or secured in a closed or an open position.

l. Placing a ladder on a track or in intertrack space, unless protection is provided, is prohibited.

m. Using a ladder lengthened by splicing two short ladders Is prohibited.

21-12. Working on or About Machinery

a. Operating machinery or equipment, unless authorized to do so, is prohibited.

b. Removing safety guards from saws, emery wheels, gears, or other parts of machinery, except for the purpose of making repairs, is prohibited.

c. Operating a machine or an appliance without safety guards or with safety guards out of position, except for test purposes or while making repairs, is prohibited.

d. Machinery must not be repaired, cleaned, oiled, or adjusted while in operation, except for oiling or adjusting powerplant machinery or other equipment requiring continuous operation.

e. Standing, climbing, or riding on a moving machine or motor is prohibited. Being on or inside a guardrail of a moving machine is prohibited.

f. Repairing, dismantling, or assembling a motor-driven machine without first opening the power switch and placing a "Danger-Do not operate" sign on the switch is prohibited. In case of a machine driven from a line shaft, the belt must be removed or the belt shifter tied in the "off" position and a DANGER sign placed on the machine.

g. A drive motor must be shut down and allowed to come to a stop before blades or dies on a shears, punch, or forging machine are changed. h. Stepping through or reaching between moving belts is prohibited. i. Operating a machine with a defective belt shifter or with a "creeping" belt, or placing the hand on a moving belt, is prohibited.

j. It is prohibited for personnel to wear rings while operating machines.

k. While machinery is being operated, gloves may not be worn, unless authorized by the supervisor.

l. Material must be properly secured before machine work is performed on it.

m. Using the hand to remove chips, cuttings, or scale from a drill, a press, or other machine is prohibited.

n. Grinding on the side of an emery wheel or a grindstone, unless the side is designed for that purpose, is prohibited A tool rest should not be more than 1/8 inch from the wheel.

o. All setscrews or keys in revolving spindles or shafts must be flush or countersunk.

p. Using a power ripsaw not equipped with a spreader is prohibited.

q. A push stick of sufficient length will be used to feed short pieces of wood or ends of long pieces through and clear or a power ripsaw. Using fingers for this purpose is prohibited.

r. Personnel must stand to the side of a power ripsaw to avoid being struck in the event of a kickback.

s. Loose or scrap material must be kept away from the saw blade.

t. On woodworking machinery, all offbearing operations should be performed on the end opposite to the feed or away from the cutting edge or side of the too].

u. Standing directly in front of an overhead swing saw while it is being operated is prohibited.

v. When operating bar shears, placing the hand between stock and shear guard is prohibited. Tongs will be used for material too short to be held down by the guard.

21-13. Working on or About Cars

a. Before a drop-bottom car door is opened, all personnel must be clear of the door on the opposite side of the car.

b. Using a wrench to hold a door-winding mechanism, while the pawl is being released from the ratchet, is prohibited. The pawl will be knocked from the ratchet and, if necessary, unwound with a ratchet or a self-adjusting car wrench. Using the fingers to release a pawl from a ratchet is prohibited.

c. The use of any wrench other than a ratchet or a self-adjusting car wrench when operating a door-winding mechanism of a drop-bottom or hopper car is prohibited. (This does not apply to a man closing a door on an empty car in a classification yard.)

d. Placing hands or fingers in the jamb or on the frame of a drop-bottom or hopper car door, or using the hands to swing or close a hopper door having a wind type lock, is prohibited.

When a drop-bottom door with wind type lock is closed, the *following* precautions will be observed:

(1) Men on the other side of the car must be clear of the door.

(2) The flange or angle on the side of the car is grasped to keep from losing balance.

(3) One foot is placed on the corrugated portion of the push or locking casting (of door). The other foot must be firmly placed to avoid slipping.

(4) The door should be pushed with the foot until it is engaged in the first notch of the lock.

(5) A bar should be used to engage a door in the second notch or closed position. The bar must be carefully placed, and the body must be braced to avoid falling if the bar slips.

e. While car doors are being opened or closed, fingers will be kept clear of the edge of the jamb of the door, the casting, or the rail on which the door travels. The body will be kept clear of the door opening.

f. Personnel must stand outside the gate and take a secure hold on the grab iron before unlatching and lowering the end gate on a gondola car.

g. Until it is known that the tension of the friction draft gear has been released, personnel must keep in the clear and warn others to keep in the clear of all attachments.

h. Attempting to remove a brake cylinder head or piston without having the piston rod sleeve clamped to prevent the spring from suddenly dislodging the head is prohibited.

i. Hands and fingers should be kept out of Journal boxes. A packing hook or tongs should be used to adjust a brass or a wedge.

j. Repairing air or steam heat lines, while the line is under pressure, is prohibited.

k. When engaged in inside work on a car about to be shifted, proper precautions must be taken to avoid injury from the sudden starting or stopping of the car. (The supervisor must notify the workmen when a shift is about to be made.)

l. Walking or standing on a passenger car seat is prohibited. m. Jumping from the roof of a closed car to open the car, or jumping from the top of a car to a car on another track, is prohibited.

n. Guiding the center pin with the hands when a car is being lowered on trucks is prohibited.

21-14. Eye Protection

a. Prescribed goggles, properly fitted, will be worn by personnel engaged in the work listed below. Personnel near enough to these operations to be exposed to their hazards must also wear prescribed goggles. This is an inviolable rule, no matter how brief the job. One exposure is enough to blind a man-the man engaged in the work, men watching the work, or men near the work.

(1) Blowing with compressed air or steam.

(2) Brazing with coke or gas.

(3) Breaking or cutting concrete, stone, asphalt, or cemented ballast.

(4) Using a handle tool to break or loosen frozen material (ground, gravel, cinder, ballast, coal, or ice).

(5) Using or dressing the grinding wheel.

(6) Heating, pouring, or otherwise handling molten metal.

(7) Paint spraying.

(8) Heating rivets.

(9) Driving or backing up rivets or staybolts.

(10) Scaling, scraping, or sandblasting.

(11) Striking metal against metal or holding metal to be struck with metal.

(12) Performing other work hazardous to the eye (to be determined by the supervisor).

(13) Chipping iron, steel, or other metals.

(14) Reaming and drilling.

(15) Soldering joints In electrical work when a metal pot is used.

(16) Cutting or backing out rivets.

(17) Autogenous welding or cutting operations.

(18) Sandblasting.

(19) Working with acids, lye, babbitt, solder, or other molten metals.

b. Objections about using goggles because they fog up, get dirty, or cause headaches can be largely overcome by following a few commonsense rules for keeping goggles clean and for proper fit.

(1) Rules for keeping goggles clean.

(a) Goggles should be held by the frame to avoid touching the lenses.

(b) Goggles should be protected when not in use.

(c) Goggles should be washed with soap and water occasionally.

(2) Proper fit.

(a) To prevent headaches, the goggles should fit properly and be clean.

(b) As nearly as possible, the eye should look through the center of each lens.

(c) The bridge strap or bead chain should be adjusted to a comfortable fit.

(d) The headband on cup goggles should be carefully adjusted with just enough tension to hold the goggles secure. The band should be worn low on the back of the head.

(e) The bow on spectacle goggles should hook behind the ear close to the head and should touch the ear evenly, not just at one or two points.

21-15. Rules for Prevention of Falls

The prevention of falls of personnel engaged in the maintenance of railway cars in one of the major accident problems. When an injury results from a fall, the true cause should be determined and the responsibility fixed. The following are some of the most common causes of falls: a. Falls Caused by Slipping

(1) Walks, steps, footboards, and gangways should be kept free from ice or snow as far as practicable. Salt should be kept available for this purpose. Sand and ashes should be used where ice or snow cannot be removed.

(2) Good housekeeping will prevent many falls on wet, oily, or greasy surfaces or on objects such as stones, coal, bolts, and nuts. Personnel should be cautioned to watch for ground irregularities and place their feet carefully.

b. Falls From Scaffolds

(1) To prevent falls from scaffolds, planks, braces, supports, and other parts should be of adequate strength and should be bolted securely. Failure to assemble securely all parts of a scaffold often results In falls.

(2) A substantial railing at the proper height (usually 42 inches) should be securely installed on all open sides of scaffolds. Toeboards should be used to prevent tools and material from slipping.

c. Falls From Ladders

(1) A good ladder of the right type and length for the job should be used The ladder should be properly placed and secured against slipping by lashing, use of safety feet, or having another man hold the ladder when conditions require.

(2) Since personnel fall more frequently going down ladders than up them, special care should be taken in descending (descend facing the ladder). A secure grip on the ladder with the foot firmly on the ladder rung is important. If the foot should slip while the grip is relaxed, a fall is difficult to prevent. Jumping from lower rungs to the ground frequently causes falls. Tools and material should be kept away from the base of the ladder.

d. Falls From Stairs or Steps. Where a handrail is provided, it should be used. Where no handrail is provided, additional care should be used. The feet should be carefully placed to avoid missteps. Running or undue haste should be avoided.

e. Falls Caused by Tripping

(1) Personnel must be alert to avoid tripping over fixed objects such as switch stands, rails, and machinery. The eyes provide the best protection. Work location should be properly lighted. Hand lamps or flashlights should be used to light pathways.

(2) Good housekeeping will prevent falls over removable objects such as tools, equipment, ties, or drawbars.

APPENDIX A

REFERENCES

A-1. Army Regulations (AR)

55-255	Railroad Equipment.
55-257	Operation of Utility Railroad Equipment.
55-650	Military Railroads.
700-53	Support of Railroad Equipment.
746-1	Color, Marking, and Preparation of Equipment for Shipment.

A-2. Field Manuals (FM)

55-1	Army Transportation Services in a Theater of Operations.
55-15	Transportation Reference Data.
55-20	Army Rail Transport Operations.

A-3. Technical Manuals (TM)

5-618	Paints and Protective Coating.
10-1101	Petroleum Handling Equipment and Operations.
38-750	The Army Maintenance Management Systems (TAMMS).
55-200	Railway Operating Rules.
55-2019	Railway Car, Kitchen, Troop.
55-2023	Rack, Test, "AB" Valve, Westinghouse Airbrake Model 511588.
55-2220-201-35	Assembly Instructions for 40-Ton Railway Freight Car Fleet (Flat, Box, Tank, High- and Low-Side Gondola) (Foreign Service).
55-2220-210-12	Operator's and Organizational Maintenance Manual: Railway Car, Guard, 56 1/2-Inch Gage, 8-Wheel, Domestic Service.

A-4. Technical Bulletins (TB)

5,5-2200-205-25/1	Installation and Servicing of Journal Lubricating Devices.

A-5. Department of the Army Pamphlets (DA Pam)

55-1	Transportation Railway Service.

A-6. Tables of Organization and Equipment (TOE)

55-228	Transportation Railway Equipment Maintenance Company, Transportation Railway Battalion.
55-248	Transportation Railway Car Repair Company.

A-7. Miscellaneous Publications

DA Supply Catalog 2200-IL, FSC Group 22, Railway Equipment.

Association of American Railroads

Code of Rules Governing the Condition of, and Repairs to, Freight and Passenger Cars for the Interchange of Traffic.

Lubrication Manual, Standard and Recommended Practice.
Wheel and Axle Manual.

Westinghouse Airbrake Company

Instruction Pamphlet No. 2502.
Instruction Pamphlet No. 5030-Single Capacity Freight Car Brake Equipment (K Triple Valve).
Instruction Pamphlet No. 5039-4-Supplement No. 1, Single Car Testing Device, Code of Tests.
Instruction Pamphlet No. 5050-44-The UC Passenger Car Brake Equipment.
Test Code Instruction Leaflet No. 2377-2.
Instruction Pamphlet No. 5050-5-UC Passenger Car Brake Equipment with U-20 (Universal Valve).
Instruction Pamphlet No. 5050-7-D-22-P Passenger Car Brake Equipment with D-22-AR (Control Valve).
Instruction Pamphlet No. 5062-The AB Freight Brake Equipment.
Instruction Pamphlet No. 5062, Supplement 1-AB-1-AB Freight Brake Equipment.
Instruction Leaflet No. 2391-Shop Maintenance, Freight Brake Equipment, AB Type Valves and Associated Devices.
Instruction Leaflet No. 2391, Supplement No. 1-Repair Track Maintenance, Freight Brake Equipment, AB Type.

New York Airbrake Company

Instructional Pamphlet No. 47.

Simmons-Boardman, Inc.

Car Builder's Cyclopedia.

GLOSSARY

The following are terms commonly used in maintenance of railway cars.

A-end of car. The end opposite to that on which the brake shaft is located, this end being called the B-end. If there are two brake shafts, the ends are designated by stenciling the letters A and B, respectively, on both sides near the ends.

Airbrake. In its widest sense, the term airbrake may include any system in which the mechanism is actuated by the manipulation of air pressures exerted on different parts of the apparatus A more restricted meaning is general in the United States, covering only brakes which employ air under pressures above atmospheric.

AB brake equipment. The type of brake equipment made standard for new freight cars built after 1 September 1933 and for rebuilt cars after 1 August 1937. AB brake equipment was made compulsory in interchange after 1 January 1945 by the Association of American Railroads (AAR). It replaced type K brakes in CONUS.

Airbrake hose. Laminated rubber and canvas tubing attached to a nipple that screws into the angle cock at the end of the brake pipe The other end of the hose is fitted with a coupling which engages with a similar coupling on the adjoining car. The complete arrangement forms a flexible air connection between the brake pipes of the two cars.

Airbrake-hose coupling. A special type of standardized fitting which is attached to one end of an airbrake hose to provide means for quick and secure connection and disconnection of the hoses by which the airbrake pipe and signal pipe are carried from car to car.

Airbrake schedule. A tabular index of times of protected operations and recurring events pertaining to the maintenance and periodical testing of airbrake equipment.

Air conditioning. In its broadest sense, the simultaneous adjustment of atmospheric conditions, chemical as well as physical, within an enclosed space to suit the purpose for which that space is used, regardless of variations in natural atmospheric conditions. This process involves control of moisture content, temperature, purity, and circulation.

Air gage (airbrake). A gage to register the pressure of air in reservoirs, brake pipe, or brake cylinders, similar to an ordinary steam pressure gage. The air gage is made either with a single pointer or with two pointers (duplex gage) to indicate on one dial both the reservoir pressure and the brake pipe pressure.

Angle cock. A special type of valve located at both ends of the brake pipe on passenger and freight cars. The free opening is threaded to receive the air connecting hose nipple.

Articulated car. A car consisting of two or more full-size units free to swivel, the portions being carried on a common-center truck. Automatic airbrake. An airbrake system in which the brake will be applied automatically in case of an accident which permits air to escape from the system.

Automobile car. A boxcar for carrying automobiles. It has exceptionally large side doors (usually double) at least 10 feet wide and sometimes has end doors. Often fitted with automobile racks. Automobile-parts car. A boxcar specially fitted for transportation of automobile parts.

Auxiliary reservoir. A reservoir for storage of compressed air to operate the brakes of each individual car. This reservoir is supplied from the main reservoir on the engine through the brake pipe.

Axle. The cylindrical steel shaft on which the car wheels are mounted. The axle not only holds the wheels to gage, but also transmits the load from the journal boxes to the wheels Axle generator. A special type of electrical generator designed for drive from the car axle by belt and pulleys or direct drive.

B-end of car (See also Designations). The end of the car on which the brake shaft is located, or the end toward which the brake-cylinder piston travels.

Ball bearing. A group of bearings which depend upon an arrangement of spherical balls (usually hardened alloy steel) and races to reduce rotational friction between two parts which bear against each other.

Bellcrank. Usually an L-shaped lever (but often with two extremities connected so as to be of triangular form) for changing the direction of motion by 900, more or less.

Belt rail. A part of a passenger car frame below the window on the outside, extending the whole length of the car body. Also applied in boxcar construction, in the double-sheathed type, to the inside horizontal strip between the side-sill filler and the upper sideplate filler. Also called girth.

Body (of a car). The main or principal part in or on which the load is placed. Body bolster bottom cover plate. The bottom cover plate used on a bolster of the built-up type. Also known as the body bolster compression bar and body bolster tie plate.

Body framing. The framework of that part of a car above the underframe. It is commonly subdivided into side, end, and roof framing.

Body post (freight car bodies). An upright piece which is fastened to the sill and plate of a freight car. The body posts and corner posts from the vertical members of the side frame of a car body.

Body side bearing. The upper one of the two side bearings. It is attached to the body bolster.

Bolster. A crossmember on the underside of a car body and in the center of a truck through which the weight is transmitted. The bolsters carry the body and truck center plates, the body bolster resting on the truck bolster.

Bolster spring. The mainspring of a car, supporting the truck bolster, on which the weight of the car body rests.

Boxcar. A car having a roof and enclosed sides and ends. Doors are placed in the sides and ends.

Brakes. The whole combination of parts by which the motion of a car or train is retarded or arrested.

Brake beam. The immediate supporting structure for the two brakeheads and the two brakeshoes acting upon any given pair of wheels.

Brake cylinder (airbrakes). A cast-iron cylinder attached to the body frame or the truck frame of a car, containing a piston which is forced outward by the compressed air to apply the brakes. When the air pressure is released, the piston is returned to its normal position by a release spring coiled about the piston rod inside the cylinder.

Brake hanger. A link or bar by which brake beams and attachments are suspended from a truck frame.

Brake levers (airbrakes). A general term designating the levers used as a part of the foundation brake gear.

Brake pipe. That section of the airbrake piping of a car which acts as a supply pipe for the reservoirs and, in the case of full pneumatic brakes, is also the sole connecting means by which the car brakes are controlled by the engineman.

Brake pipe air strainer. A strainer inserted in the brake pipe to prevent foreign matter from entering the brake apparatus under the car. Brake shaft. An iron or steel shaft of a handbrake. It is usually vertical (but sometimes horizontal), and it has a handwheel or a handle and ratchet on one end by means of which a chain connected to the brake levers may be wound on the shaft and the brakes applied.

Brakeshoe The cast-iron shelf which is held against the car wheel to produce braking action.

Brakeshoe key. A key or wedge by which a brakeshoe is fastened to a brakehead It is inserted through a keyway in the face of the brakehead and the lug on the birakeshoe.

Brake step. A small shelf or ledge on the end of a freight car, near the top, on which the brakeman stands when operating the handbrake.

Branch pipe (airbrake). A pipe extending from the brake pipe to the triple valve in the K-type brake, from the brake pipe to the AB valve in the AB equipment, and from the brake pipe to the ABEL-1 valve when the AB automatic empty and load brake is used.

Branch pipe strainer. A dirt collector used in the branch pipe.

Branch pipe tee (airbrake). A tee used to connect the branch pipe to the brake or train pipe. Brine tank. Sheet metal containers placed at the ends or overhead in a refrigerator car for the purpose of carrying salt water and ice.

Carline. Framing members which extend across the top of a car from one side to the other and support the roof.

Center plate. One of pair of plates which fit one into the other and which support the car body on the trucks, allowing them to turn freely under the car. The center pin or kingbolt passes through both, but does not really serve

as a pivot. The body center plate or male center plate is attached to the underside of the body bolster, or, in cast-steel bolsters, is made an integral part of the casting. The female or truck center plate is attached to the top side of, or cast integral with, the truck bolster.

Center sill. The central longitudinal member of the underframe of a car. This sill forms the backbone of the underframe.

Centrifugal dirt collector. A device connected in the branch pipe between the brake pipe and distributing valve or triple valve and so connected that owing to the combined action of centrifugal force and gravity, dirt and foreign material are automatically eliminated from the air flowing through the collector chamber. By means of a plug, the dirt thus collected may be removed without breaking any pipe connections whatever

Changeover valve (airbrakes). A valve used with double capacity brakes to enable changing from "empty" to "load" brake. Check valve (triple valve). The valve under the emergency valve which prevents brake cylinder pressure from escaping back into the trainline when a hose bursts or the train parts.

Composite. Made up of distinct parts of elements.

Coupler (car). The device by means of which cars can be automatically connected and disconnected.

Coupler head. The portion of the coupler which houses the coupling mechanism.

Coupler horn. The projecting lug cast on the head of the coupler which bears on the striking plate when the draft gear is closed solid.

Coupler-knuckle lock. The block which drops into position when the knuckle closes and holds it in place, preventing uncoupling.

Coupler lock lifter. The part of the mechanism inside the coupler head which is moved by the uncoupling rod and in moving lifts the knuckle lock so that the knuckle can open.

Coupler shank. The portion of the coupler behind the coupler head.

Coupler yoke. The yoke or strap that surrounds the draft gear and is keyed or riveted to the end of the coupler shank. Also called draft yoke.

Cover plate. In the metal underframe of cars, a plate which is riveted or welded to the flanges of the center sills to give them additional vertical strength as in a box girder. The plate riveted to the top flanges is called a top cover plate and the one riveted to the bottom flanges, a bottom cover plate.

Crossbearer. A transverse member of the underframe, placed between the bolsters, which acts as a tie between the various sills and helps to distribute the weight of the cars.

Designations. Facing the B end of the car, in their order on the right side of the car, wheels, journal boxes, and contained parts (excluding box lids) are known as R1, R2, R3, and R4, and similarly, those on the left side of the car are known as L1, L2, L3, and L4. The same order of numbers is used for designating corresponding locations of brake beams.

Dome cover. The closure for the top of a tank car dome.

Draft gear. That unit which forms the connection between the coupler rigging and the center sill. The purpose of this unit is to receive the shocks incidental to train movements and coupling of cars and so spread out the force of impact that the maximum unit stress is brought within the capacity of the car structure.

Draft gear attachments. The parts which connect the coupler and the draft gear.

Draft gear pocket. The space occupied by the draft gear and followers in the center of draft sills.

Draft lug. One of a set of stops riveted, bolted, or welded to the draft sills and transmitting to them the stresses received from the draft gear.

Dust collector (airbrake). A device for preventing dust or pipe scale from passing to an airbrake valve mechanism.

Dust guard. An ordinary dust guard may be a thin piece of wood, leather, felt, asbestos, or other material inserted in the dust chamber at the back of a journal box. The dust guard fits closely around the dust guard bearing of the axle.

Elliptic spring. A spring shaped like an ellipse and composed of two sets of parallel steel plates, called leaves, of constantly decreasing length. Such springs generally are used for bolster springs for passenger cars.

Emergency reservoir. A reservoir for storage of compressed air to operate the brakes of individual cars in an emergency application.

Empty and load brake equipment (freight). Equipment which gives, automatically, practically uniform braking power whether loaded or empty.

End sill. The transverse member of the underframe of a car, extended across the ends of all the longitudinal sills.

End train pipe valve (steam heating). A valve in the train steampipe at the end of the car by which the steam supply may be cut off.

Equalizer (passenger equipment trucks). A wrought-iron or steel piece which bears on top of the journal boxes and extends longitudinally from one to the other.

Equalizer spring. A spring which rests on an equalizing bar and carries part of the weight of a car. Single or double-coil spiral or helical springs are generally used for this purpose.

Express car. A car operated in passenger trains for carrying express matter. Often combined with facilities for handling baggage or mail.

Fascia. A plain board or plate running the length or width of the car directly under the roof.

Foundation brake gear. The levers, rods, brake beams, etc. , by which the piston rod of the brake cylinder is connected to the brakeshoes in such a manner that, when air pressure forces the piston out, the brakeshoes are forced against the wheels.

Friction draft gear. Any form of draft gear which makes use of friction for absorbing and dissipating part of the energy of buffing and tension shocks transmitted through the couplers.

Geared brake. A handbrake which employs gear wheels to increase braking force. Head-end system. A system of furnishing electric power for a complete railway train from a single generating plant located on the locomotive, on the tender, or on one of the cars of the train.

Hotbox. An overheated journal caused by excessive friction between bearing and journal, lack of lubricant, or foreign matter.

I-beam. A rolled-steel commercial bar whose cross section has the form of the letter I.

Ice bunker (refrigerator car). The receptacle or compartment in which the ice is placed in a refrigerator car.

Journal. The part of an axle on which the journal bearing rests.

Journal bearing. A combination of rollers and races or a block of metal, usually brass or bronze, in contact with a journal on which the load rests.

Journal bearing wedge. A device used to hold the journal bearing in place, to distribute the load evenly over the bearing, and to allow it to be removed easily. Journal box. The metal housing which encloses the journal of a car axle and the journal bearing and wedge and which holds the oil and packing for lubricating the journal.

Journal box lubricator. A device for supplying oil to a car journal bearing. This device takes the place of the ordinary form of waste packing.

Journal brass. A solid type journal bearing.

Knuckle (coupler). The rotating coupling hook by means of which coupling is effected when the knuckle is locked by the catch or lock.

Knuckle pin (coupler). The pin holding the knuckle in the jaws of the coupler.

Knuckle thrower. A device which throws the knuckle of a car coupler open when the uncoupling rigging is operated.

L1, L2, L3, and L4. (See Designations.)

Lamp regulator. An electrical device which holds the voltage of the utilization circuits of the car electrical system constant during variations in the generator voltage necessary for battery charging.

Lateral motion. The motion which takes place crosswise of the track.

Load limit (on rail). The combined light weight and load weight of a car, which gives the maximum AAR axle loading.

Load limit (in car). That weight of load in a car which, when added to the light weight of the car, gives the maximum AAR axle loading.

Main reservoir (airbrake). A cylindrical tank carried on a locomotive or a motorcar to hold a supply of compressed air.

Nailing strip. A strip of wood laid over a metal frame and bolted to it to which the boards are nailed in a combined wood and steel car or an all-steel car.

Non-pressure head (brake cylinder). The cover for the end of the brake cylinder opposite to that having air pressure against it. Packing cup. A packing of composition material which has largely replaced leather for airbrake cylinders.

Packing ring (airbrake). A circular metallic ring of variable rectangular cross section which is placed in grooves in the edge of the piston to make it fit airtight in the cylinder.

Pedestal (truck). In old designs of build-up trucks, a casting in somewhat the form of an inverted U bolted to the truck frame to hold the journal box in place horizontally, but permitting a vertical movement. In modern trucks, pedestals are cast integrally with the truck frame.

Piston. A metal disk with packing, etc. , made to fit in a cylinder and transmit the power caused by the pressure of a working fluid to the external

rod and working parts of some form of engine. In a brake cylinder, the piston transfers the pressure of the air to the foundation brake gear.

R1, R2, R3, and R4. (See Designations)

Release valve (airbrake). A cock for reducing air pressure in the auxiliary reservoir when the locomotive is detached or when the apparatus is out of order, so as to release or "bleed" the brakes.

Reservoir (airbrake). A cylindrical container. Main reservoirs of large capacity are placed under all motorcars having air compressors; auxiliary reservoirs are placed under all cars equipped with automatic airbrakes. In freight service, a cast-iron auxiliary reservoir is connected directly with the brake cylinder and triple valve.

Reservoir pipe (airbrake). Also called air pipe and discharge pipe The pipe conveying the air from the air compressor to the main reservoir.

Ridge pole. A longitudinal member in the center of a roof, supported by the carllnes or rafters (of wooden cars), on which the roof boards rest.

Rocker side bearing. A device somewhat similar to the roller side bearing. Instead of rollers, rockers are used, which offer a gradually increasing resistance to the lateral motion of the bolster and force it to return to its normal position at all times.

Roller bearing. The general term applied to a group of bearings which depend upon the action of a set of rollers to reduce rotational friction.

Roller side bearing. A side bearing fitted with rollers to reduce friction.

Roof handhold (boxcars and stock cars). An iron bar bent to a required shape and fastened to the roof to be grasped when ascending the ladder at the end of the car.

Running board. A plane surface made of boards or a special metal structure on which trainmen may walk. It may be placed on the roof of the caboose, boxcars, stock cars, refrigerator cars, and covered hopper cars, and at the sides of tank cars. (No longer required by AAR rules in CONUS.)

Safety valve (car heating). A pressure relief valve which protects against an accumulation of excess pressure.

Safety valve (high-speed brake). A relief valve applied to the brake cylinders of cars which are not equipped with a high-speed reducing valve to relieve the brakes from excessive pressure.

Safety valve (tank car). A valve attached to the dome of a tank car to prevent excess pressure due to the vapors arising from volatile liquids.

Safety vent. An opening formed by a hollow casting or a piece of pipe inserted in the dome of a tank car. It is used on cars carrying products which are nonflammable or do not give off flammable vapors.

Shank (coupler). That part of a coupler between the butt and the head.

Sheathing. The covering around the sides and ends of a car Tongue and groove lumber is used on wooden cars and steel plates on all steel cars. On steel-frame cars, horizontal wood sheathing is generally applied

Side bearings. Bearings attached to the bolsters of a car body or truck on each side of the center plate to steady the car and prevent excessive rocking.

Side frame. The frame which forms the side of a car body or a truck.

S*ide sill*. The outside longitudinal members of the underframe.

Skirt. An extension 'of the sheathing below the side sill on passenger cars.

Spring plank. A transverse member underneath a truck bolster on which the bolster springs rest.

Stake pocket (gondola and flatcars). A metal receptacle or collar attached to the side and end sills to receive the end of a stake which supports the side or confines the load. Also, used near the top of gondola cars to receive the stakes used in applying a coke rack or other appliance for increasing the depth of the car.

Stringer. A floor nailing strip or a steel member which acts as a support for a nailing strip.

Swivel-butt coupler. A coupler in which the solid shank has been replaced by a swivel-butt casting connected to the coupler itself by means of a pin. This arrangement permits the coupler head to swivel without causing eccentric loads.

Tank dome. A vertical cylinder attached to the top of a tank car. It permits the tank proper to be filled to full cubic capacity, which would be impossible if there were no dome.

Tank head. The end sheet of a cylindrical tank.

Tape size. Circumference of the wheel at the wheel tread.

Trainline. The complete line of airbrake, air signal, or steam heat pipes in a railroad train

Transfer table. A platform structure consisting of steel girders mounted on car wheels. This platform is used to allocate cars to their respective repair stalls in shops. The transfer table operates in a pit located along the side of a shop so that the rails [of the table may be made to register with tracks leading to the various stalls.

Tread (of a car wheel). The exterior cylindrical surface of a car wheel next to the flange which comes in contact with the rail.

Triple valve (airbrake). A device which automatically performs three functions in operating the airbrakes. This valve charges the auxiliary reservoir and applies and releases the brakes according to the varying pressures in the trainline.

Truck. The general term covering the assembly of parts comprising the structures which support a car body at each end (or, in the case of articulated cars, the joint support of two abutting car ends) and provide for attachment of wheels and axles.

Truck bolster. A crossmember in the center of a truck, on which the car body rests. The truck bolster is connected to the body bolster by a center pin, which passes through both. Truck frame. A structure made of cast steel in one piece to which the journal boxes or pedestals, springs, and other parts are attached The truck frame forms the skeleton of a truck.

Truck side bearing (See also Side bearings). A device attached to the top of the truck bolster and having an upper bearing surface which comes in contact with a similar bearing surface fastened to the underside of the body bolster

Truck side frame. The longitudinal portion of a truck structure on the outside of the wheels. The side frame extends from one axle to the other. Journal boxes and bolsters or transoms are attached to or form a part of this frame.

Truck springs. The springs that carry the weight of the car body and its load.

Uncoupling lever or uncoupling rod. A rod with a bent handle forming a lever, usually attached to the end sill, by which the lock of the automatic coupler is opened and the cars uncoupled without personnel going between them. The lever proper is the part attached to the rod and operates the unloading mechanism, but, in the case of freight cars, the lever and rod are generally made in one piece. The short lever, which is directly connected to a passenger coupler, is also sometimes called an uncoupling lever.

Underframe. A framework which receives buffing and pulling stresses and carries the weight of the floor and body of the vehicle.

Universal valve. A valve mechanism used with UC passenger brake equipment which corresponds in a general way to the triple valve in that it operates to charge the reservoirs and to control the admission of air to, and exhaust of air from, the brake cylinder.

Vapor regulating valve (car heating). A valve by which the amount of steam admitted to the heater pipe is controlled. For a more detailed description of operation of the valve used with the pressure and vapor car heating system, see Vapor reservoir.

Vapor reservoir. Used in the pressure and vapor car heating system in conjunction with the vapor regulating valve. It is placed below the blowoff (or drip) valve, forming an extension to it, and consists of a spiral coil of copper piping surrounding a pipe which forms an extension to the flowoff valve.

Vent valve (airbrake). A pneumatically operated valve placed in the airbrake pipe to insure quick action of the brake especially when the brakes are cut out on one or more of the first cars in a train. It is also used when cars equipped with quick-action devices may be placed too far apart in a train.

Wainscoting. The lining for interior walls of a passenger car body. Term applies especially when paneling and relatively elaborate workmanship are employed.

Wainscot panel (passenger car interior). A panel under the windows between the two wainscot rails.

*Waste. T*hreads of wool or cotton or mixtures of these into which is incorporated mechanically curled vegetable fiber, often coconut fiber, to Impart to the product an elasticity not possessed by wool or cotton threads. The material is saturated with lubricating oil and placed in a journal box so that it comes in contact with the lower half of the journal. Sometimes called packing or dope.

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